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PLANNED PROGRAM UNNECESSARY

America's oil reserves are adequate to meet all demands of the foreseeable future, and there is now available a reserve productive capacity of 700,000 barrels daily to meet any national emergency, according to National Petroleum Council's special committee on Crude Petroleum Reserve Productive Capacity. It is estimated that in addition to these reserves, another million barrels daily could be made available by rationing of oil products to the public in a national emergency. In view of the available reserve capacity there is little immediate need for commercial scale production of liquid fuels from coal or shale, in the opinion of the committee. Should a national emergency arise, substantial quantities of synthetic liquid fuels can be obtained from natural gas, coal, or oil shale. Development of such resources on a large scale is likely to occur eventually, even in the normal course of events, when prices warrant.

One of the important factors contributing to the increase in domestic reserves is the technical developments in conservation practices. New technical developments and their application, combined with state conservation laws prevent waste and protect correlative rights of competing operators in a field. State conservation laws authorize conservation agencies to restrict production to market demand. "Experience demonstrates that production in excess of market demand often leads to uneven and inequitable withdrawals by different operators in the same field, resulting in conditions that bring about physical waste in the reservoir. Production greater than market demand leads likewise to excessive storage with consequent losses from evaporation, fire, and other hazards. Furthermore, failure to consider market demand in regulating production would give the new, flush fields with low costs so great an advantage over old fields as to cause premature abandonment of wells and loss of reserves that would otherwise be recovered." The loss in reserves by failing to consider market demand cannot and should not be overlooked.

Reserve petroleum productive capacity in the United States, without taking into account imports or exports, is estimated by the committee to have been about 500,000 barrels daily average during 1949 and 700,000 barrels daily at the end of the year. Existing reserve capacity appears to be substantial for a national emergency. "It is probable that reserve productive capacity will remain substantial over the next few years. An increase of 2.5 per cent a year in demand between 1949 and 1953 would result in domestic requirements in 1953 of about 6,350,000 barrels daily, or about 1,000,000 barrels daily below the availability of 7,320,000 barrels daily, which probably would be attained under favorable circumstances. It appears, therefore, that a substantial reserve productive capacity, of the order of magnitude of 1,000,000 barrels daily, probably will prevail in the period 1950-53 in the absence of any new developments tending to upset the present outlook for supply and demand."

The committee concludes that no plans or programs are necessary or would help to achieve a substantial reserve-producing capacity. "The normal competitive operations of the industry, in a favorable economic climate, unhampered by new regulations, will tend to bring about larger productive capacity that will provide a satisfactory margin of reserve productive capacity."—K.C.S.

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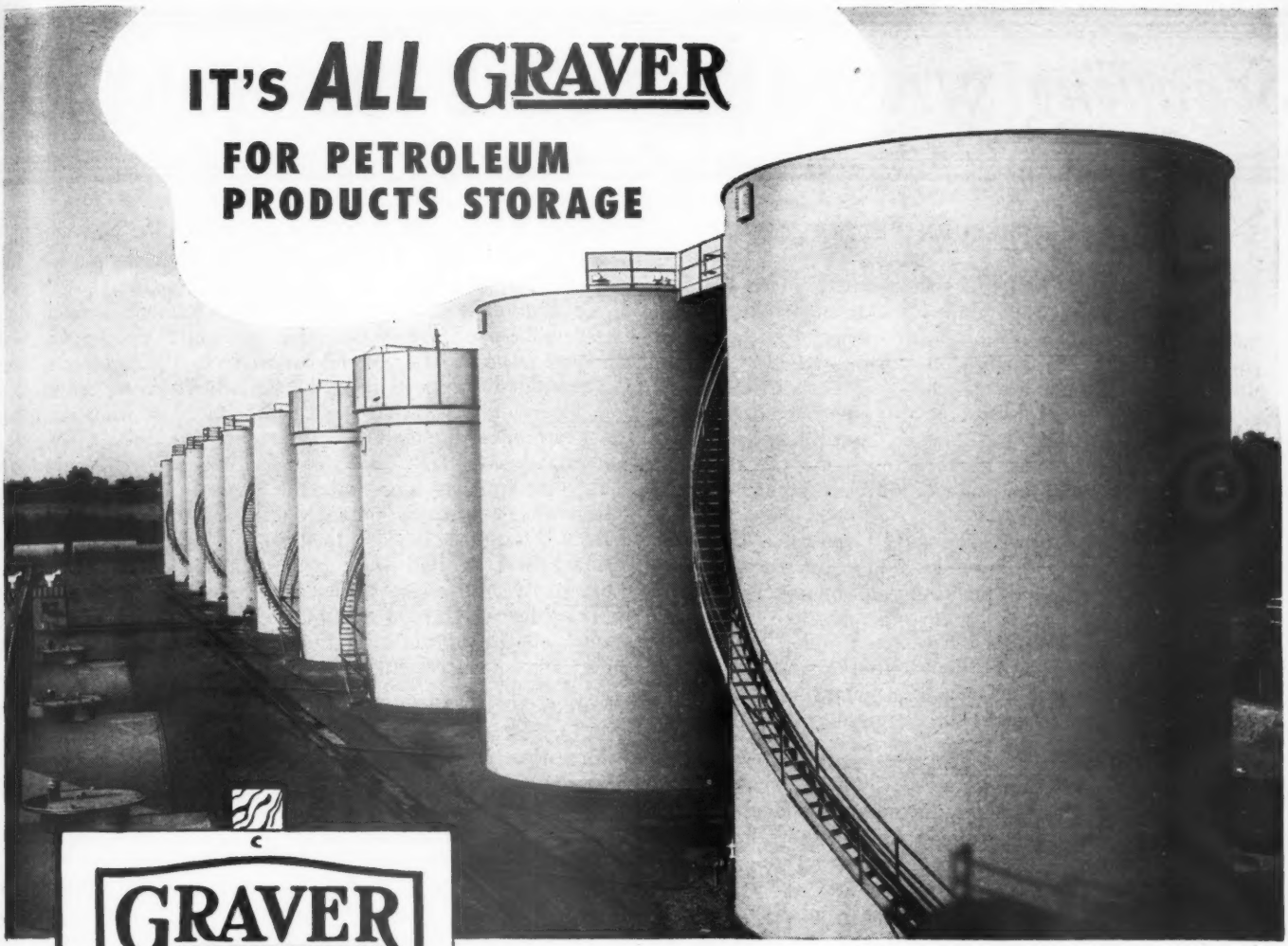

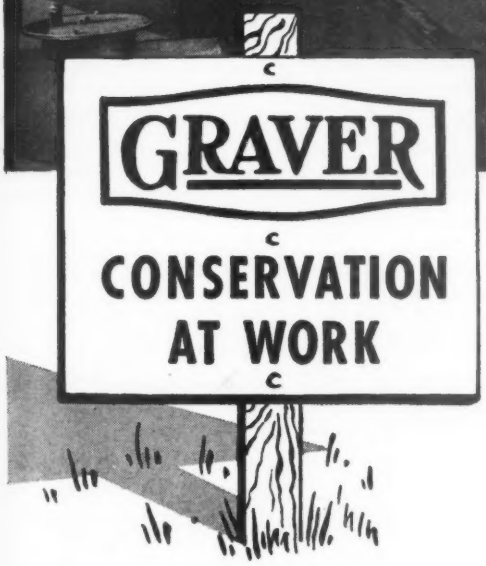

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Scanning WASHINGTON'S OIL HORIZON

By MILBURN PETTY

WASHINGTON—All this talk about the need for a national policy on oil may culminate soon in definite steps to develop such a policy, although it is likely to go beyond oil and gas. It may be extended to cover all fuels, including studies of the inter-relationships of all forms of energy.

Defense Secretary Johnson recently suggested to the White House that something be done to coordinate federal oil policies. The assignment went to Interior Secretary Chapman who has tackled the job with enthusiasm, although not much has been announced so far.

In Congress, the House Commerce Committee's oil group plans a full-scale investigation, looking to the formulation of a national policy on fuels, including oil and gas. Rep. Harris (D, Arkansas), chairman of the subcommittee, was disappointed when the National Petroleum Council opposed his bill for this purpose. Harris thought that the industry should participate in the development of a government oil policy and had warned that otherwise they might not like the result.

▸ **Gas vs Oil.** The recent warm weather has intensified the worries of refiners and marketers over the increasing competition of natural gas. A few have even listened, speculatively, to proposals from outside the industry that gas be taxed but, as a whole, they are unlikely to go along with the idea of thus equalizing competition.

One refiner's suggestion that the NPC study the matter of gas vs oil competition boomeranged when Secretary Chapman endorsed the proposal but also wanted a similar study to be made by the coal people, with Interior Department coordinating the work of both groups.

So, the NPC probably won't go ahead with it. This is no time to promote a fight between the oil and gas industries, commented one NPC member, pointing to the Truman Administration's attack on the oil and gas depletion allowance.

▸ **Depletion.** Greatest danger in defending the depletion allowance from President Truman's attack is that the industry may become over-confident due to past victories.

Truman couched his tax message with a Rooseveltian appeal to the "common man," offering to trade repeal of the wartime nuisance taxes for changes in the depletion allowance and climaxing it with charges that oil millionaires were going tax-free while the low income groups were taxed. It's hard to beat an appeal like that in an election year.

Several oil state members of Congress believe that the chances are 50-50 that Truman may succeed in rolling back the 27½ per cent oil-gas allowance but not all the way to 15 per cent, as Treasury would like. Other oil state senators and congressmen are hopeful that the attack can be beaten off, this session—at least. All of them warn against rumors, even from the White House, that the attack on the depletion allowance will not be pressed.

▸ **Imports.** The urgent need for the industry to close ranks and defend itself from outside attacks was one reason behind the importing companies recently announcing cutbacks in their import schedules. Another factor was the increasing support developing in Congress for limitation of imports. It now seems likely that the Truman Administration will do something in this direction (as was predicted in this column last month).

Ironically, when the iron was the hottest, disagreement developed among the independents as to what sort of relief should be sought, with some fearing that legislation for import quotas might lead to federal oil control.

Still another element was Secretary Chapman's conclusion —even before he heard from the National Petroleum Council —that imports had become excessive and that some action was needed to relieve the domestic industry from the impact of foreign oil. And that was Chapman's reply when Truman asked him for his views on the import situation.

So, when the NPC came along with its import report finding that imports have hurt the domestic industry, it was somewhat of an anticlimax. Even though the original request from Interior asked NPC to study and submit recommendations, the NPC had nothing to suggest. A few members—led by W. A. Jones (Cities Service) and B. L. Majewski (Deep Rock)—urged that the Council follow through and work out a program of action with Secretary Chapman but they were unsuccessful.

▸ **British Oil.** NPC's failure to make any recommendations on imports, despite its findings of fact about the impact on domestic producers, was all the more noticeable because the import report did make a positive suggestion that the U. S. government take steps to permit American companies to compete in international oil trade "free of the insurmountable obstacles" imposed by the British government.

But the American foreign operators may find that, with President Truman worked up over the U. S. import situation, it may not be difficult to persuade the administration to do something that will lessen the pressure on them to bring foreign oil into this country.

▸ **Canada.** There is reason to believe that President Truman regards Canadian oil as a supplementary source for the U. S. So, it would not be surprising if any limitation on imports will be easier on that country than others. In fact, the State Department has indicated to Senator Wiley (R, Wisconsin) that reduction of the tariff on Canadian crude may be considered at the trade agreement negotiations beginning this September. Wiley had inquired on behalf of a constituent interested in building a refinery at Superior, Wisconsin, to run on Canadian oil.

▸ **Tankers.** Navy's opposition to laying up some 60 tankers, and chartering privately-owned vessels instead, is weakening. These tankers were loaned to Navy by the U. S. Maritime Commission, which is now seeking to have them laid up so that the tanker situation can be relieved somewhat.

▸ **Leasing.** It's a safe bet that Interior Department will bury Assistant Secretary Davidson's idea of refusing to issue a non-competitive lease where the land involved has been proved up since filing of the lease application. The NPC jumped on it with both feet. And Chapman has never favored the idea, anyway.

▸ **California.** Imminence of some kind of federal antitrust action against the West Coast oil industry, covering all aspects from the well to filling station, has heightened interest in a new move for a state oil conservation law. Many independents, including some of the very largest, who have opposed such bills in the past are now reported favoring a state proration law. One angle of the prospective antitrust suit likely will be an attack on the voluntary conservation program.

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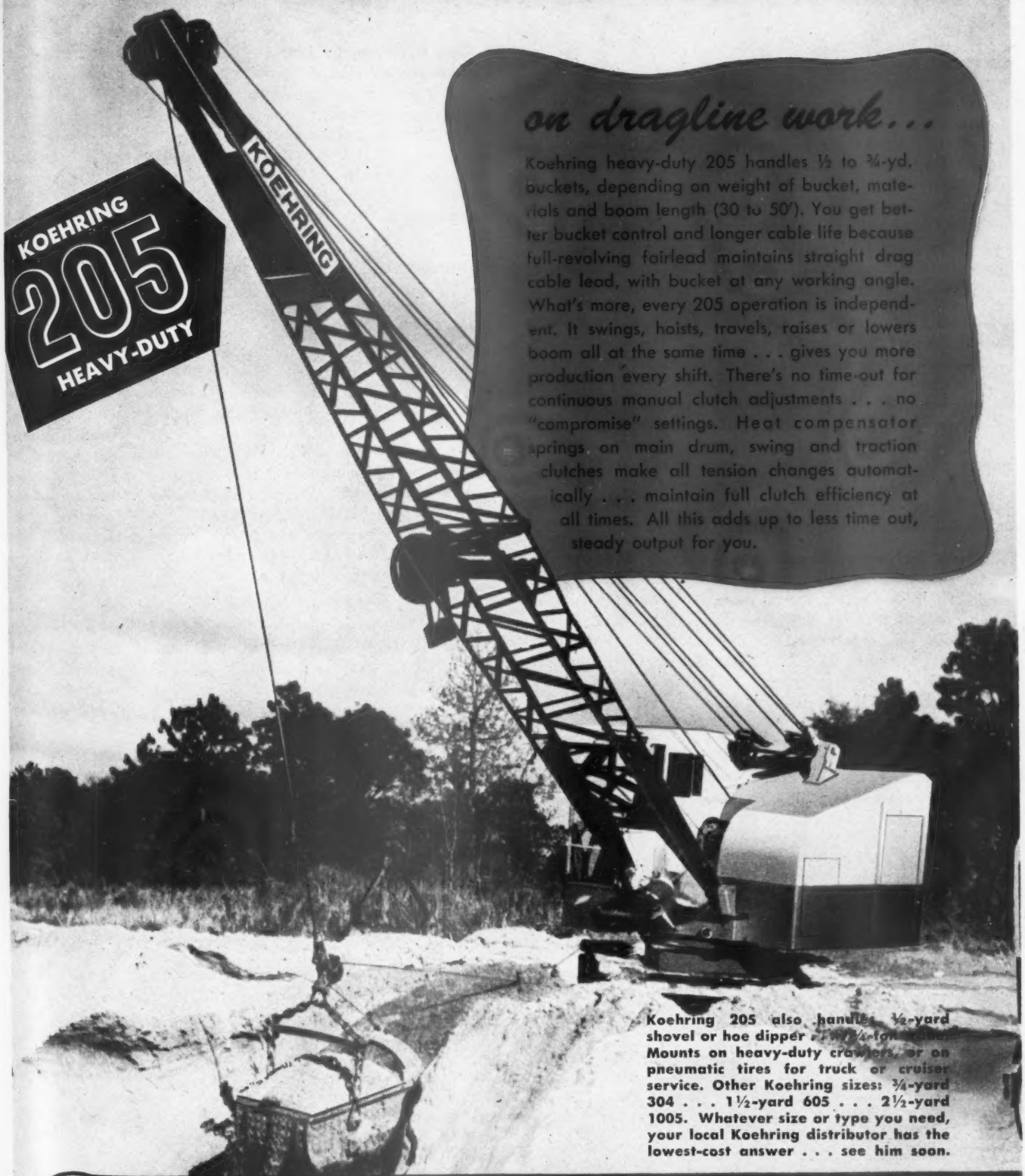

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Highlights in Oildom

Report Russia-China Pact. Reports, still unconfirmed, have stated that the Chinese Communist Chairman, Mao Tung already had wangled import deals with the Soviet Russians before he went to Moscow in December. According to the report Soviet representatives in China have promised extensive Russian economic and technical aid in return for concessions in China, notably in oil and mining. If the report is true, the Sino-Soviet concern under Russian management, but with China holding a theoretical 51 per cent of the stock, will develop oil concessions in Sinkiang and Kansu provinces. In addition to oil and coal, iron and tungsten resources in Sinkiang and Kanus are to be developed.

Canada Will Import Oil In '52, Says Hewetson. Statisticians of Imperial Oil Limited of Toronto, Ontario, Canada, are not as optimistic about the future of Canadian oil production as some petroleum analysts. Henry H. Hewetson, chairman of the board of Imperial, speaking in Tulsa, Oklahoma recently, stated that figures compiled by his company on future business of the company indicate Canada will import more crude oil and products in 1952 than it is doing now. He stated that his company figures that in 1952 demand for crude oil and products will average 386,800 bbl daily and that production will average 114,000 bbl a day in 1952.

British Refinery Requires Less ECA Money. The British Government will not need quite as many dollars to run its Shell-Haven refinery as the ECA had agreed to pay. Instead of a 66,000-bbl plant, the unit will have capacity of only 40,000 bbl. Initial cost was figured at $58,400,000, of which $10,043,00 would be furnished by ECA. Revising the figures, the British government placed the cost at $34 millions, and ECA will furnish $2,455,000.

Voluntary Import Cuts Lessen Pressure. Pressure to force the discontinuation of importing has been somewhat eased recently, by the voluntary action on the part of leading oil companies to cut imports. The Texas Company led the companies in making this reduction, followed by Standard Oil Company (New Jersey) and its affiliates, Shell Oil Company, and Socony-Vacuum.

WPRA Report on Small Refiners. A survey conducted by the Western Petroleum Refiners Association disclosed that the smaller refiners in Kansas, Oklahoma, and North Texas, who purchased all or most of their crude oil requirements, lost money in December. The survey consisted of a study of refinery operations relative to product yields, operating costs, and realization of plants in these areas having capacities of 4000 to 8000 bbl a day crude throughput.

NPC Reports Production May Increase. The National Petroleum Council has reported that the American oil industry's reserve productive capacity of 700,000 bbl daily may soon reach the 1,000,000-bbl level. These estimates are the result of a survey begun last year at the request of the government. NPC's findings were reported by a committee under the direction of L. F. McCollum, president of Continental Oil Company.

The industry's productive reserve for 1949 averaged 6,300,000 bbl daily, the McCollum committee reported, and 6,450,000 bbl for December. Proved underground reserves increased by 1,250,000 bbl, McCollum said, bringing the national total to an all-time high.

Gas Distributor Subject to Federal Regulation. A natural gas distributor operating wholly within one state is nevertheless subject to federal regulation, is the decision of the Supreme Court. The decision settled a 10-year controversy between the East Ohio Gas Company, Cleveland, Ohio, and the Federal Power Commission. The Court opiniated that it could not interpret the law as meaning that Congress meant to create an exception for every company transporting interstate gas in only one state. The government regarded the suit as a guide for some 43 similar cases.

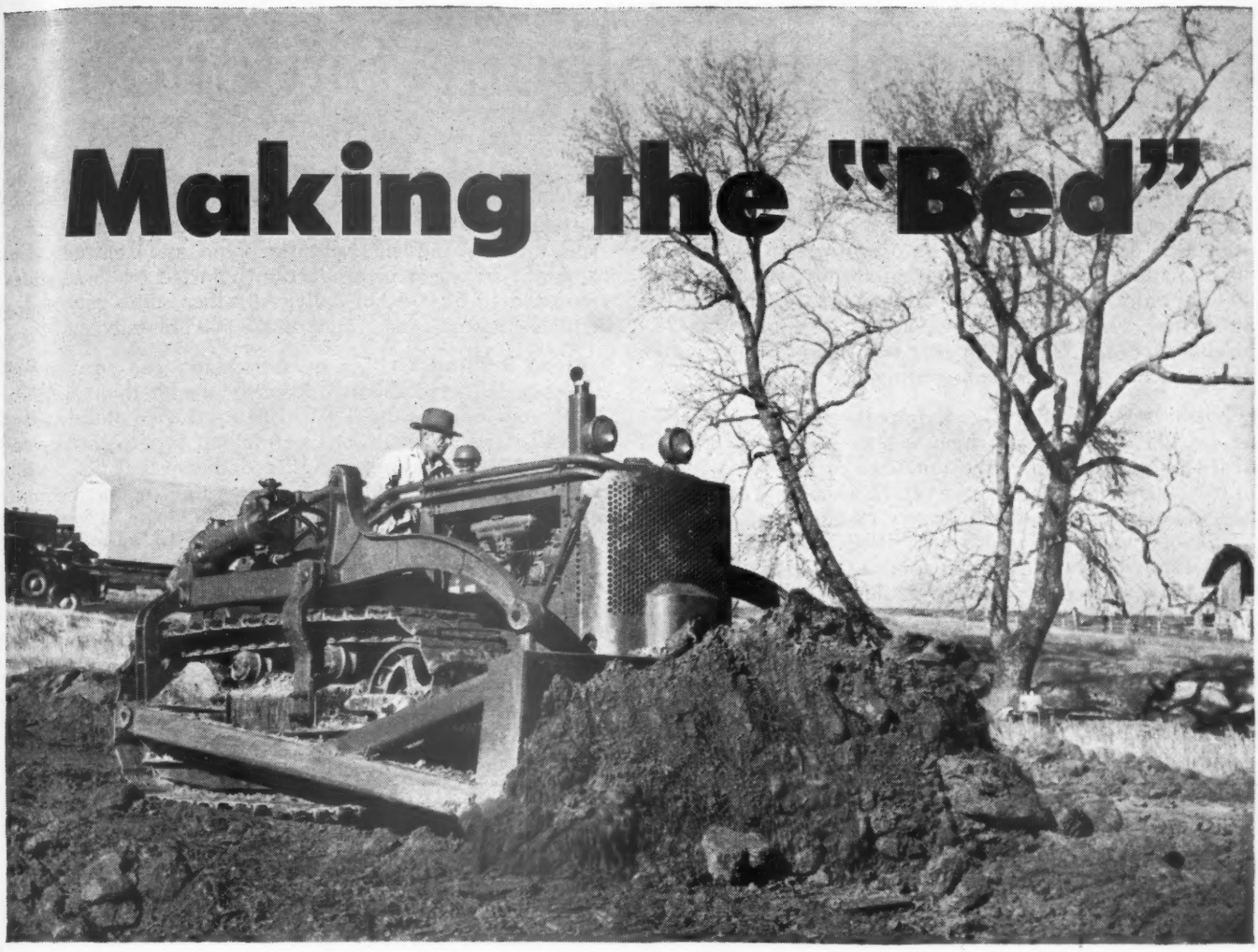
Oklahoma Corporation Sets Gas Prices. The Oklahoma Supreme Court has ruled that the state Corporation Commission has the authority to fix a price for natural gas at the well head, in the interest of conservation, in the Guymon-Hugoton field. The Commission ruled that the old price, set in 1947, of 4 cents per cubic foot was so low as to create economic waste, and it ordered a 7-cent price. It directed its order against the producers rather than the gas companies, which operate in interstate commerce. As a result, the producers in the field were required to make bond to cover the differential in price. The Cities Service Gas Company is joining with Phillips Petroleum Company preparing a petition seeking reversal of the Supreme Court's decision. Cities Service has challenged the power of the Corporation not only to fix prices, but to set conditions on products destined for interstate commerce.

Estimate Increased Demand for Oils. The Bureau of Mines has estimated that the demand for all oils for the first quarter of 1950 will be 6,511,000 bbl daily, an increase of 4.5 per cent over the same period of 1949. The demand for domestic production of crude oil to meet consumption and export was set at 5,190,000 bbl daily, compared with an estimate of 5,230,000 bbl daily in December.

Ball Believes There's Plenty of Oil. In the opinion of Max W. Ball, former director of the U. S. Department of Interior's oil and gas division, "we won't run out of oil—ever." Speaking before the Mid-Continent regional meeting of the American Association of Petroleum Geologists, Ball predicted this country might run short of oil, but even that won't happen if we continue present discovery operations. Since the war, Ball added, discovery wells have progressed at such a rate that production could be stepped up 750,000 bbl a day.

Use of Oil and Gas as Fuel Increases. If the figures mean anything, oil and gas is gradually replacing coal as fuel. The U. S. Bureau of Mines have prepared figures showing that home owners used 87,747,000 tons of coal during 1948, 27 per cent below the 124,906,000 tons used during 1943, the year of heaviest consumption during the past decade. Home heating oil sales have risen steadily from a daily average of 380,000 bbl in 1939 to 929,000 bbl in 1948. In 1943, oil sales averaged 570,000 bbl. In the same decade, use of oil by industry rose from 896,000 to 1,398,000 bbl daily.

U. T. Collects $9,418,804.64 on Oil Lands. The University of Texas collected $9,418,804.64 from its oil property last year, according to the General Land Office records. The school received $7,789,254 last year from royalties; bonus and rental payments added $1,629,549. This amount is approximately 6 times as large as it was 6 years ago.



For a Drill Rig

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National Petroleum Situation

Supply, Demand Balance. Despite unseasonable weather, oversupply of crude and products, and the rising tide of imports, the U. S. oil industry performed another miracle in 1949 by trimming its operations to fit the economic pattern. The year's supply of all oils average 6,105,000 bbl daily, while demand averaged 6,101,000 bbl daily. Since June 30, the industry managed to reduce stocks 27,515,000 bbl, and closed the year with its stock level practically unchanged from the preceding year.

Imports Up 23 Per Cent. Imports of all oils in 1949 totaled 230,478,000 bbl, which was an increase over 1948 of approximately 23 per cent. Imports of crude oil amounted to 153,386,000 bbl, an increase of 24,293,000 bbl over 1948. Imports of refined products, largely residual fuel oils, were 77,092,000 bbl, an increase over 1948 of 18,476,000 bbl. Imports of all oil in 1949 averaged 631,000 bbl daily, which was 118,000 bbl daily above 1948 imports. This quantity, plus a decline in total demand last year of 28,000 bbl daily, created a handicap in supply of 146,000 bbl daily.

Production Cut-Back. National crude production in 1949 was reduced about 464,000 bbl daily below the rate reported in 1948. Texas accounted for a reduction in daily production of 431,000 bbl, which represented a cut under 1948 of about 7 per cent. Contrary to the general trend, increases were reported in 1949 by Louisiana, New Mexico, West Virginia, Indiana, Nebraska, Ohio, and Colorado. The combined increases in production reported by these states amounted to 61,000 bbl daily. All other states reported a combined reduction in output of 525,000 bbl daily.

More Drilling. Drilling operations in 1949, exclusive of service wells, were about 3 per cent greater than in 1948. Total completions were 37,701 against 36,747 wells drilled in 1948. Wildcat operations were about 9 per cent greater than in 1948. Preliminary figures indicate that 6872 wildcats were drilled in 1949, which was the greatest number drilled to date. In 1948 out of every 5 wildcats, 4 were dry, and in development drilling 1 well out of every 4 wells was dry.

Demand Cross-Currents. While the demand for all oils in 1949 showed a net decline under 1948 of about 1 per cent, the demand for gasoline was greater by 5 per cent. However, unseasonably warm weather during the 1948-49 heating season reduced the demand for fuel oils by about 4 per cent.

Comparative Statistics, January, 1950

*All figures are computed on a Bureau of Mines' Basis**

	Dec. 1949Ⓟ	Nov. 1949Ⓟ	Dec. 1948	This Year to date	Last Year to date	Per cent change
Total supply, all oils	192,881	191,539	209,802	2,228,588	2,349,828	— 5
Daily average	6,222	6,384	6,768	6,105	6,420	
Total demand†, all oils	207,881	195,988	205,396	2,227,012	2,243,326	— 1
Daily average	6,706	6,533	6,626	6,101	6,129	
Change in stocks	—15,000	—4,449	+ 4,406	+1,576	106,502	
Crude supply	169,520	169,223	190,876	1,994,979	2,145,375	— 7
Daily average	5,470	5,640	6,157	5,465	5,861	
Crude demand	167,267	164,145	184,688	1,993,343	2,119,775	— 6
Daily average	5,395	5,471	5,958	5,461	5,518	
Crude stocks	253,185	256,010	256,254	253,185	256,254	— 1
Days supply	47	46	43	47	43	
Natural gasoline production	14,810	13,935	13,448	156,333	145,479	+ 7
Daily average	480	450	434	428	397	
Motor fuel production	83,810	79,733	83,279	962,086	921,902	+ 4
Daily average	2,703	2,657	2,686	2,636	2,519	
Gasoline yield per cent	41.0	43.6	41.6	41.5	38.2	+ 3.3
Motor fuel demand	75,774	78,536	75,428	950,796	908,610	+ 5
Daily average	2,444	2,618	2,433	2,605	2,482	
Motor fuel stocks	112,350	104,314	101,001	112,350	101,001	+11
Days supply	46	39	41	46	40	
Fuel oil production	67,950	64,282	74,550	763,026	846,780	—10
Daily average	2,192	2,142	2,405	2,090	2,313	
Fuel oil demand	92,864	78,675	89,814	843,617	875,154	— 4
Daily average	2,996	2,622	2,418	2,311	2,309	
Fuel oil stocks	136,680	153,324	152,895	136,680	152,895	—10
Days supply	45	57	63	45	63	
Refinery still runs	168,610	158,782	177,335	1,944,406	2,030,670	— 4
Daily average	5,440	5,293	5,720	5,324	5,548	
Stocks, all oil	607,196	622,196	607,302	607,196	607,302	0
Days supply	90	91	92	90	92	

Current Crude Oil Prices

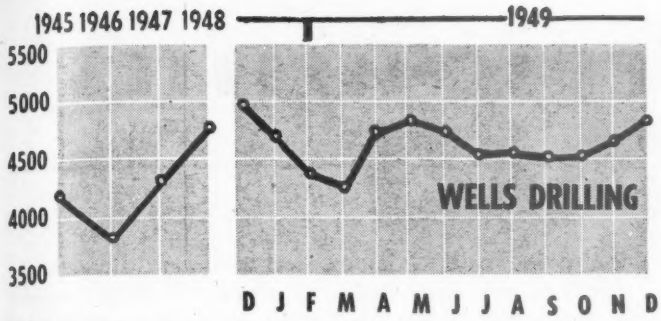
U. S. Average	$2.55	Louisiana	$2.62
Texas	2.61	Arkansas	2.43
California	2.42	New Mexico	2.40
Oklahoma	2.63	Mississippi	2.26
Kansas	2.62	Illinois	2.76
		Other states	2.60

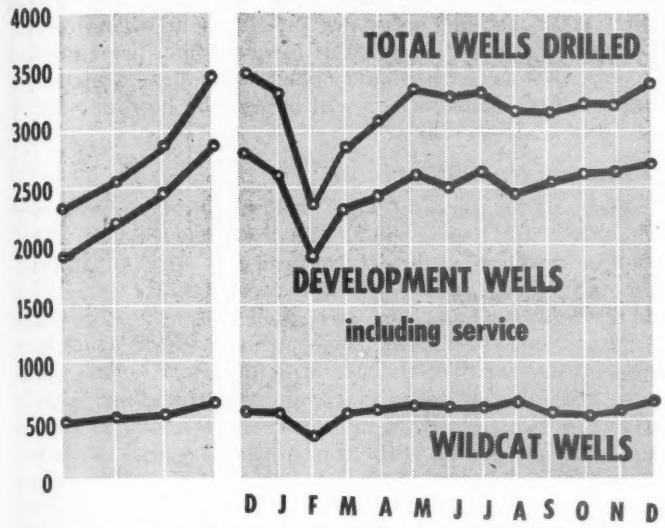
Basic crude prices:	
Oklahoma-Kansas (36 gr.)	$2.57
Texas Gulf Coast (36 gr.)	2.80
East Texas	2.65
West Texas (36 gr.)	2.44
California Signal Hill (26 gr.)	2.31
Pennsylvania, Bradford	3.40

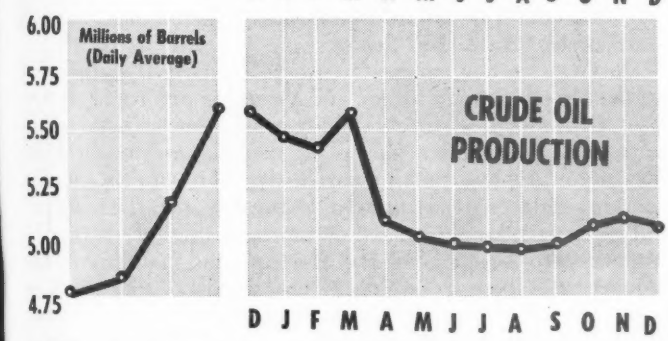
Drilling and Production Statistics

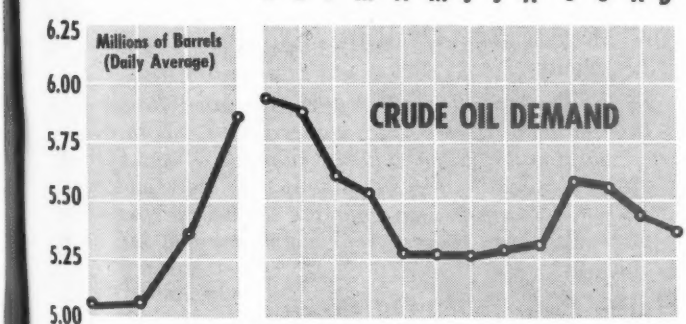
	Dec. 1949Ⓟ	Nov. 1949Ⓟ	Dec. 1948	This Year to date	Last Year to date	Per cent change
Wells Drilling	4,915	4,770	5,125	4,915	5,125	— 4
Total wells drilled	3,450	3,318	3,507	38,885	38,906	0
Development wells	2,761	2,711	2,763	30,829	30,442	+ 1
Oil	1,847	1,785	1,907	20,697	21,068	— 2
Gas	243	242	236	2,776	2,584	+ 7
Dry	671	684	620	7,446	6,790	+10
Per cent dry	24.3	25.2	22.4	24.2	22.3	+ 1.9
Service wells	109	70	171	1,184	2,159	—45
Wildcat wells	580	537	573	6,872	6,305	+ 9
Oil	84	67	85	1,113	960	+16
Gas	13	15	15	203	245	—17
Dry	483	455	473	5,556	5,100	+ 9
Per cent dry	83.5	84.9	82.5	80.8	80.9	— 0.1
By State						
Wells drilled (excl service)	3,341	3,248	3,336	37,701	36,747	+ 3
Arkansas	20	30	32	327	314	+ 4
California	174	210	238	2,510	2,852	—12
Illinois	256	268	231	2,648	2,461	+ 8
Kansas	330	314	303	3,348	3,161	+ 6
Louisiana	244	196	186	2,400	2,281	+ 5
Mississippi	23	25	38	332	414	—20
New Mexico	37	40	58	483	600	—19
Oklahoma	413	392	380	4,291	4,210	+ 2
Texas	1,261	1,097	1,140	13,930	12,167	+14
Other states	583	636	730	7,432	8,287	—10
Wildcats drilled	580	537	573	6,872	6,305	+ 9
Arkansas	8	6	11	72	103	—30
California	25	29	43	465	482	— 4
Illinois	54	55	46	535	441	+21
Kansas	61	42	34	533	517	+ 3
Louisiana	20	23	37	306	309	+ 1
Mississippi	9	10	14	111	109	+ 2
New Mexico	5	4	11	78	69	+11
Oklahoma	75	63	62	797	808	— 1
Texas	248	199	219	2,978	2,519	+18
Other states	75	106	96	997	948	+ 5
Daily crude production	5,033	5,209	5,688	5,045	5,509	— 8
Arkansas	82	80	87	81	86	— 6
California	858	860	950	910	929	— 2
Illinois	173	176	178	175	176	— 1
Kansas	291	305	314	280	303	— 8
Louisiana	560	540	521	522	495	+ 5
Mississippi	100	100	128	104	125	—17
New Mexico	136	140	136	132	131	+ 1
Oklahoma	406	455	450	415	420	— 1
Texas	2,023	2,174	2,553	2,036	2,467	— 7
Wyoming	128	135	144	127	147	—13
Other states	276	244	227	263	230	+14

*Unless otherwise stated all figures represent thousands of barrels. Ⓟ–Premliinary. *Includes domestic production and imports.
†Total demand, including exports.
Preliminary estimates based upon data supplied by American Petroleum Institute, U. S. Bureau of Mines, State Agencies, and other official sources.

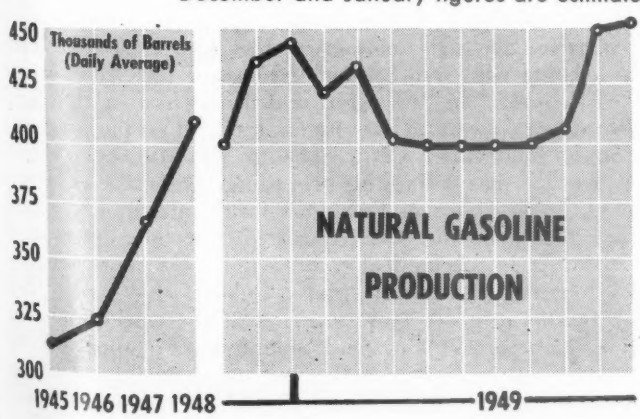


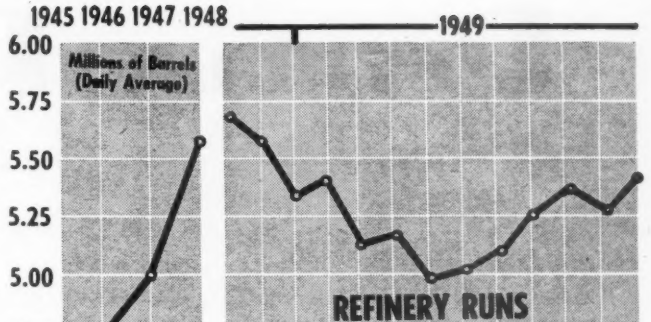


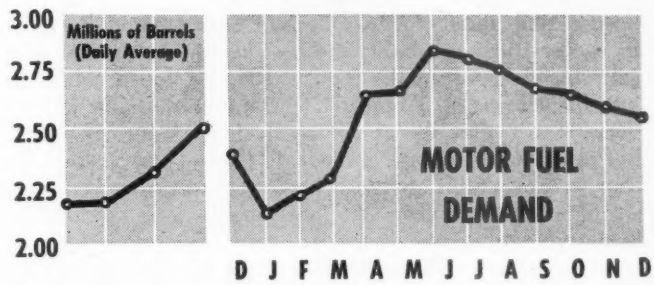


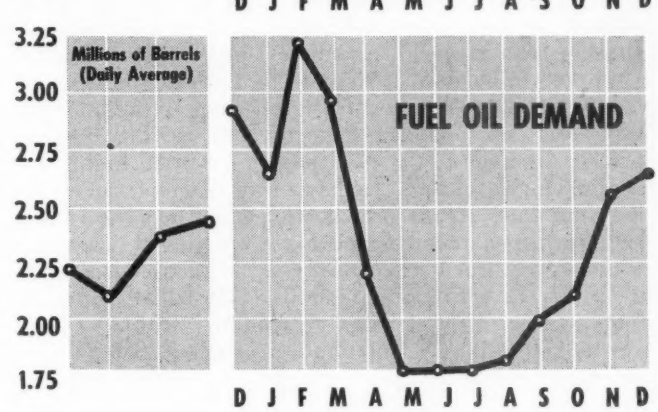


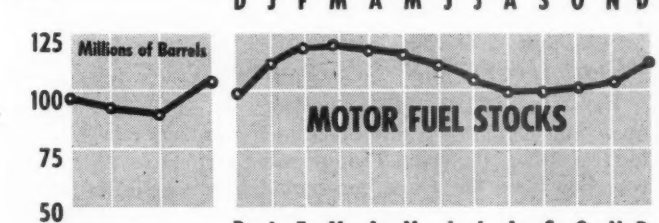
December and January figures are estimates.

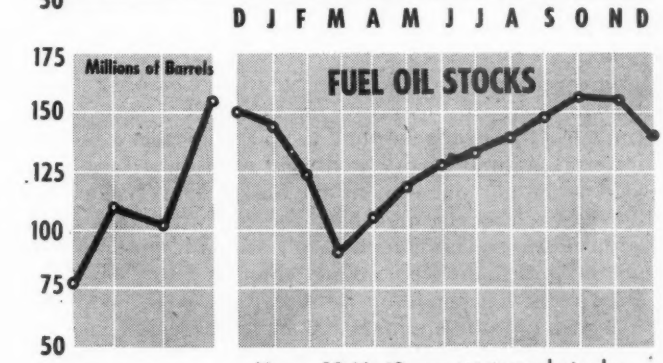




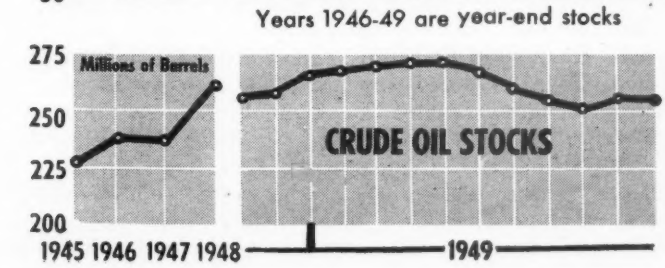








Years 1946-49 are year-end stocks



PETROLIC PERSONALITIES

DICK SNEDDON

Home Is the Hero

Teague and Freestone County in East Texas really killed the fatted calf on Wednesday, January 18, when its favorite son, *Bill Boyd, Jr.*, for 29 years the Pasha of the Petroleum people, threw aside his mace, doffed his ermine wrap, and snuck back, not furtively but eagerly, to the homey haunts of his boyhood. It wasn't that there was anything callous or even casual about the way he had been treated by the oil folks, for Bill is probably the best known and most universally liked person in the industry. He no doubt could have had his choice of a hundred executive positions when he decided to resign one of the top posts in American oildom, but he chose instead to go back to the old friends and familiar scenes of his youth. That old hometown yen grows stronger with the years and yielding to it is as human as tears and laughter.

One of the qualities that lifted Bill Boyd to such a high altitude in the greatest industry extant is what the public speaking experts call "audience contact". No matter what your stature businesswise, when he talks to you he has the faculty of excluding, or at least appearing to exclude, everything and everyone else. It is just you and Bill Boyd in a private discussion of a moot point or a brief, highly confidential story exchange. He has a way of unobtrusively making your interests his, which at once conveys the idea that he likes you, so of course you go for him in a big way. Along with this natural born capacity to make friends and keep them, he has a fine administrative talent that has enabled him as prexy of American Petroleum Institute to resolve any and all differences that have arisen, and to bind a complexity of keenly competitive petroleum people into a harmononious and distinctly effective entity.

"Dear Hearts and Gentle People"

But returning to the celebration: It all started with an open house in Bill's new office at the entrance to his farm lodge, midway between Teague and Fairfield on U. S. Highway 84. Here his right hand was shaken so often and so vigorously that the arm has lengthened appreciably. We have heard, indeed, that he can now tie his shoelaces without stooping. From his office the multitude surged out on to the farm property where the Lone Star Gas Company spudded in an oil well, Bill Boyd No. 1, so that the neophyte pharmer won't feel too strange around the place. Besides you can get dry cows as well as dry wells and even on a farm it isn't good to put all your eggs in one basket. Our Teague operative tells us that the first thing Bill did when he arrived at the farm was to check up and see how many cows were flowing and how many were on the pump.

Active in the spudding in of the new well, incidentally, were such petrolic luminaries as *R. L. Wheelock*, vice president of API; *D. A. Hulcy* of Dallas, president of Lone Star Gas Company; and *Raymond J. Dillard*, an executive of the J. K. Hughes Oil Company. Then followed a street parade, free movies, and congratulatory speeches by all sorts of Vips, including Senator *Tom Connally;* Congressman *Olin Teague;* Lt. Governor *G. C. Morris; Hines H. Baker*, president of Humble Oil Company; *W. Alton Jones*, president of Cities Service Oil Company, and a raft of civic dignitaries and other notables all of whom said so many nice things about Bill Boyd, we wouldn't be a bit surprised if that other Bill Boyd they call Hopalong Cassidy is insane with jealousy. There is no need to recite the long list of Bill Boyd's accomplishments here. Every oil man in America knows him as well as we do and every last one of them will rejoice in Teague's official recognition of his good qualities and good works. Now as he turns independent operator and gentleman farmer these same oil men will be wishing him the most of the best—and so will we!

Fine Feathered Friend

Next to the Empire State Building, Radio Center, and South Pacific, it is probable that the greatest single attraction in New York at the present time is *O. W. "Ox" Morgan, Jr.*, the Byron Jackson behemoth who recently ditched out of his home state and took up residence in the bustling bailiwick of New Amsterdam. The Morgan anatomy, which is no less substantial than the two structures just mentioned, is now tastefully attired in morning coat, striped pants, suede gloves, velvet collared overcoat, satin scarf, grey spats, and up to, if you please, a Homburg. They say that the haberdasher who handled the contract had quite a time selling the benny with the turned up brim. He asked the California dreadnaught if he would like to have a Homburg, and was curtly told, "Naw, I've just et!"

Anyway, in due course Ox was fully arrayed in the style of the big city business man, and a striking picture he makes, too! Of a morning, indeed, many a pretty head is turned to watch the immaculate one as he strolls majestically down Lexington Avenue, flicking carelessly at bits of this and that with his malacca. It is rumored, by the way, that the resourceful chap is taking instruction in nasal diction so that he won't feel so conspicuous. It is also rumored that the Morgan household is likely to be enlarged by at least one along about February 12. If the stork doesn't send the wrong kind and arrives on schedule, the new comer may be named "Honest Abe" Morgan, and, who knows, may some day be the father of his country.

Flash: Over the United Press, Associated Press, and International News Service comes exciting word of the arrival, January 22, of a husky young lad, Kent Gilbert Morgan, *weighing 8½ lb without saddle or spurs, and a likely looking prospect for the Byron Jackson sales force. PS: The "Honest Abe" cognomen will just have to wait.*

Marco Polo from California

An interesting chap with whom we had the recent pleasure of a short visit was *Jim Murphy*, associate director of research for Shell Oil Company at Houston, Texas. We found him being convoyed around the city of Los Angeles with *Pen Penfield*, Shell's California drilling chief; a high ranking player in western canasta circles; and no pushover in a domino joust either. Getting back to Jim Murphy, however, we learned that despite his prevailing love of the Lone Star state, he was born in Petaluma, California, and is a stout Bear rooter, having been graduated from the University of California in mechanical engineering some years ago. Jim is a regular 20th century Marco Polo. He has visited Shell operations in every remote corner of the world, including jungles, deserts, plains, and mountains. To top it off, his meanderings were still farther expanded during a two-year hitch with the U. S. Navy, which carried him to Australia.

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New Guinea, the Philippines and the lesser and greater elements of the Micronesian group. Since the conclusion of the hot war he has settled down in Houston where there is no disturbance other than the cold war with Dallas.

Jim used to be quite a yachtsman in his day, and still dresses himself in a reefer and sou'wester occasionally to do a bit of neat belaying with a marlinspike, and generally keep his nautical hand in. Once our seagoing operatives tell us, he was feeling his way cautiously in a yawl or a sloop or something through choppy seas in a dense fog off Long Beach. Suddenly a light loomed up faintly a short distance over the bow. Luffing his mizzen mast, Captain Jim yelled in exasperation, "Avast there! Where are you going with that ship?" "No place," was the calm reply, "This ain't a ship—it's Catalina Island."

Deer and Antelope Play

A recent visitor in the deep south was *Larry E. "Mac" McCord*, Shell Oil Company scout in the Rocky Mountain district, and apparently closely associated with *Eddie McDowd*, the well-known Celtic cribbage and chess expert. Mac, McCord that is, is a Notre Dame grad in civil engineering of the vintage '36, and is a fearless chap who has tested his skill in a wide variety of sports. He has beaten an obstinate golf ball with a mashie until it no longer had either shape or substance; he has hunted deer and antelope until they were so exhausted they came in and gave themselves up; and he has faced the vicious Chinese pheasant without knowing a word of the language, and with no other weapon than a BB gun. He occasionally fishes too in the rugged mountain streams of the northwest and there isn't a trout between Casper and Denver that doesn't warn its children against the depredations of this insistent Waltonian.

Mac was actually born in Chicago and his grammar school diploma has the bullet holes to prove it. He came west, however, in good time, tied in with the Shell at Casper and except for some time spent in England with the 8th Air Force has been up in the mountain country ever since.

Arabian Knights

Another lad with whom we had the pleasure of trading greetings a short time ago was *Sam Dykes*, Iraq Petroleum Company driller, who spent his last few foreign months at Qatar but has been stationed for about two years in Anzalah, near Mosul. Sam worked two years for Socony, in New Zealand. In fact, his boy, *Lyle*, was born there—he calls the youngster a "pig islander". While he was working on a wildcat well out in Mushorah about a year ago, a terrific rainfall washed out the bridges and left the boys isolated for two weeks. Sam, *Deak Graham*, and *Ted Kopp* finally became so hungry they mounted a trio of Arabian horses, rode the 35 miles to Anzalah and got the transports started back in, thus eliciting loud and prolonged cheers from the crews. Guess the most popular pastime over there is eating and when that is interrupted folks get in a bad way.

Deak Graham, in case you don't know, acquires his first name from the fact that he almost became a minister. He ought to be getting some excellent material out there for sermons if he should ever change his mind and follow his original inclination.

Bows to a Lady

Again harking back to the Great White Way, the air is positively stuffy these days with stories of a very ritzy cocktail party, held in the New York Waldorf by *Elmer Decker*, the Long Beach equestrian and man about town, in behalf of his very lovely daughter, *Donna*. The young lady, as nearly as we can figure it out, beat all competition and emerged from a keenly contested tournament as national champion in the stock saddle seat, or words to that effect. Whatever it means, we admire and envy Donna no end. The only time we ever mounted a live horse, the animal looked around, sneered, pirouetted three times, fell over itself backwards, and mashed our puny frame to a quivering pulp. Of course, the frame was quivering for some time before it was mashed, but whose business is that? Anyway, since that time we have even been frightened to death of hobby horses.

Swiftly getting back on the beam at this stage, it is our best advice that the party was a perfectly decorous affair, with no weight indicators in evidence, but lots of excellent provender—liquid and solid. There were scads of important people on hand to pay homage to the young lady, among them, to mention a few, the Bill Farrands, the Frank Schlemmers, the Bob Kettenbergs, and the Dick Morrisons.

Those Traveling Men

We hear that *Wally Gilbert* will be back on home soil by the time this hits the press, and will immediately thereafter leave for Venezuela on a new assignment. Last time we saw Wally was at the Tulsa Oil Show where he was buzzing around with a camera of his own making trying to take four photographs at once. It has nothing to do with the subject but why is it that when a fellow looks natural he doesn't look pleasant and when he looks pleasant he doesn't look natural? *Templaar-Leitz*, one of Shell's better domino players, and a research whiz on the side, left on the S.S. Queen Mary a short time ago for Europe, particularly The Hague.

Joe Robinson, the Santa Fe drilling prexy, and sergeant-at-arms for the Petroleum Production Pioneers, is back in the United States again as we write from a jaunt to South America; and *Frank Gess* of the same institution last we heard was on his way to Italy. *Henry Salvatori*, the Petroleum Club president is down sunning at Palm Springs. *Ned Brown* is in Kuwait and will probably stay there for some time. *Dick Dowrick* has recruited a crew in San Francisco, which is on its way to Saudi-Arabia. And, speaking of that part of the country, we learn that *Jim Gosline* is now over in Dharhan, and if they haven't had surf fishing in the Persian Gulf up to now, it may be expected to start any minute. *Mo Johnston* has been spotted up around Las Vegas on a business trip. Well, there are many kinds of business!

Continuing the passing parade, *Mitch Mitchell*, the Security Engineering export rep, left early this month for a trip into the Canadian northwest. He will visit the company's New Westminster plant, and thence will go on up to Calgary and Edmonton.

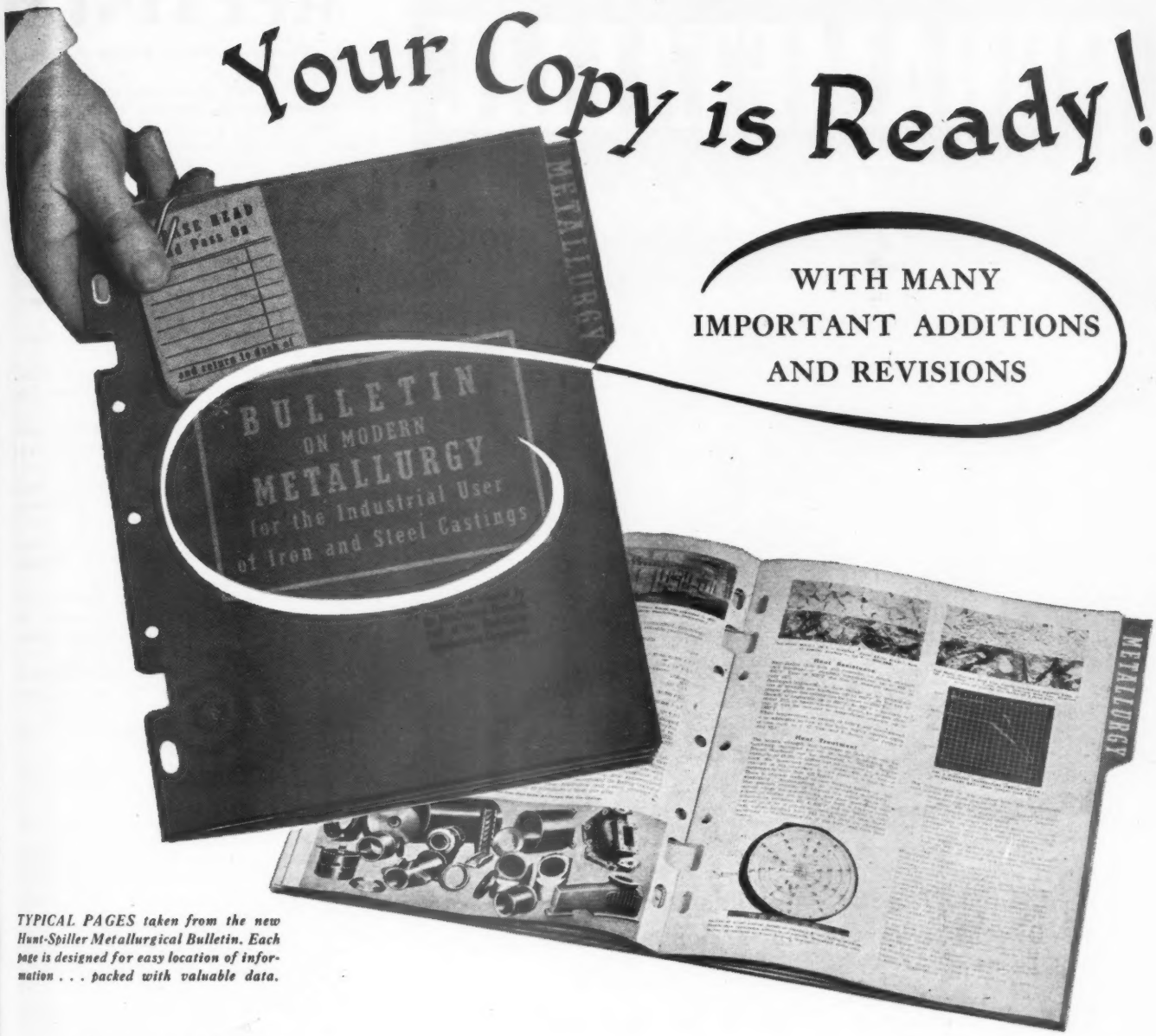
Sam Bowlby is the new president of Petroleum Production Pioneers with *Glenn Merkley* in the vice presidential spot, and *Red Aubert* looking after the money bags. *Ed Stearns* of Universal Consolidated has been named honorary president and *Max App* is honorary vice president. *Ted Sutter* the perennial historian was reelected to that post. The little export group of which Mitch, the aforementioned, is a prominent member, has shifted its headquarters to the Officers Club out on Wilshire Boulevard in Los Angeles. *Bill Bettis* is readying some interesting news on this enterprise which can't be broken yet, but we might just mention in passing that any operator in foreign fields is welcome to sit in with these boys at their regular Tuesday luncheon. Having sampled their hospitality, we recommend it highly.

We were vastly distressed to learn that our good friend, *Clint Eddleman*, purchasing agent for the Amerada Petroleum Corporation in California, has just returned home from the hospital following a serious operation and is building up his strength for another one. Clint is a pretty swell individual and we and lots of others are going to be pulling hard for him in the struggle to regain his health.

Congratulations are now in order for *Max App*, the three cushion billiardist who has *Willie Hoppe* about ready to abdicate his throne. Max celebrated his wedding anniversary January 30; we wish him and Mrs. App many more of them.

Your Copy is Ready!

WITH MANY IMPORTANT ADDITIONS AND REVISIONS



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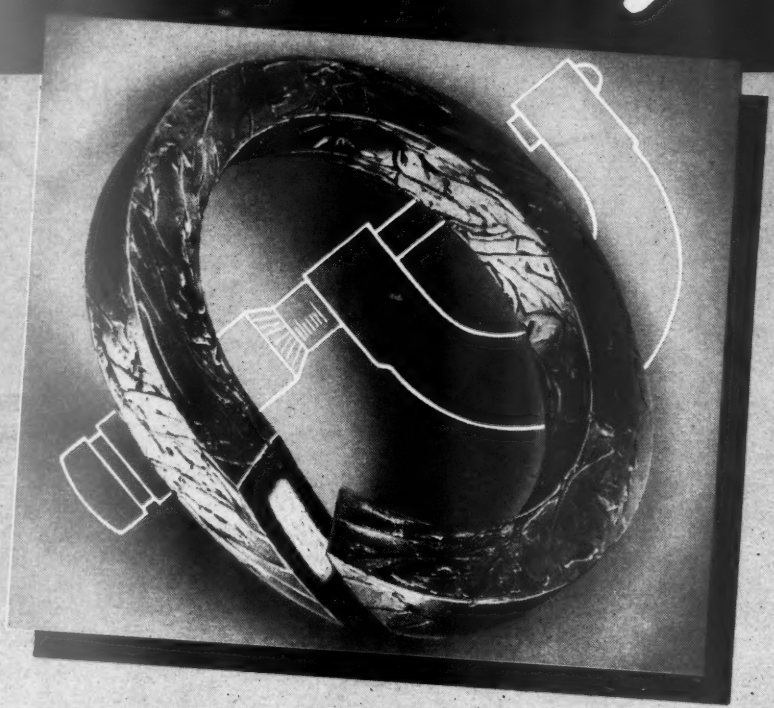

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MEETINGS

Feb. 27—Mar. 2—ASTM, William Penn Hotel, Pittsburgh, Pa.

Mar. 5-7—Safety Conference and Exposition, Annual Meeting, Peabody Hotel, Memphis, Tenn.

Mar. 8-10—API, Production Division, Southwestern District, Adolphus Hotel, Dallas, Texas.

Mar. 25—North Texas Oil and Gas Assn, Annual Meeting, Kemp Hotel, Wichita Falls.

Mar. 26-30—American Chemical Society, 1st Session, National Meeting, Houston, Texas.

Mar. 27-29—Western Petroleum Refiners Assn, Annual Meeting, Plaza Hotel, San Antonio, Texas.

Mar. 27-29—Southern Gas Association, Galveston, Texas.

Mar. 29-31—API, Production Division, Mid-Continent District, Skirvin Hotel, Oklahoma City, Okla.

Apr. 3-5—American Gas Assn, Distribution Motor Vehicle and Corrosion Conference, Hotel Book-Cadillac, Detroit, Michigan.

Apr. 4-7—National Assn of Corrosion Engineers, Annual Conference and Exhibition, Jefferson Hotel, St. Louis, Mo.

Apr. 5-7—Midwest Power Conference, Illinois Inst. of Technology, Sherman Hotel, Chicago, Ill.

Apr. 9-13—American Chemical Society, 2nd Session, National Meeting, Philadelphia, Pa.

Apr. 10-14—ASME, Hotel Statler, Washington, D. C.

Apr. 11-13—Southwestern Gas Measurement, Short Course, University of Oklahoma, Norman, Okla.

Apr. 12-14—National Petroleum Assn, Hotel Cleveland, Cleveland, Ohio.

Apr. 13-14—API, Production Division, Rocky Mountain District, Gladstone Hotel, Casper, Wyoming.

Apr. 16-20—American Chemical Society, 3rd Session, National Meeting, Detroit, Mich.

Apr. 24-25—Industrial Accident Prevention Assn, Royal York Hotel, Toronto, Canada.

Apr. 24-26—NGAA, Annual Convention, Texas Hotel, Ft. Worth, Texas.

Apr. 24-27—AAPG, Society of Economic Paleontologists, and Society of Exploration Geophysicists, Annual Meeting, Stevens Hotel, Chicago, Ill.

Apr. 26-28—API, Production Division, Eastern District, Cleveland Hotel, Cleveland, Ohio.

Apr. 27-29—National Lane Truck Carriers, Inc., Mid-Year Meeting, Palmer House, Chicago, Illinois.

Apr. 28-29—Indiana Gas Assn, French Lick Springs Hotel, French Lick, Indiana.

May 1-4—API, Refining Division, Mid-Year Meeting, Hotel Cleveland, Cleveland, Ohio.

May 1-4—American Geophysical Union, Annual Meeting, Washington, D. C.

May 4-6—Interstate Oil Compact Commission, Spring Meeting, Buena Vista Hotel, Biloxi, Miss.

May 7-9—IPAA, Mid-Year Meeting, Biltmore Hotel, Los Angeles, Calif.

May 7-9—National Stripper Well Association, Biltmore Hotel, Los Angeles, Calif.

May 8-9—American Gas Assn, Natural Gas Dept., Spring Meeting, The Mayo, Tulsa, Okla.

May 8-11—Liquefied Petroleum Gas Assn, Annual Convention and Trade Show, Palmer House, Chicago, Illinois.

May 11-12—API, Division of Production, Spring Meeting, Biltmore, Los Angeles, Calif.

May 11-12—American Gas Assn, Executive Conference, The Broadmoor, Colorado Springs, Colorado.

May 15-17—Oil Industry Information Committee, Chicago, Ill.

May 29-31—Fifth Annual Short Course in Gas Technology, Texas A & I, Kingsville, Texas.

(Continued on Page 20)

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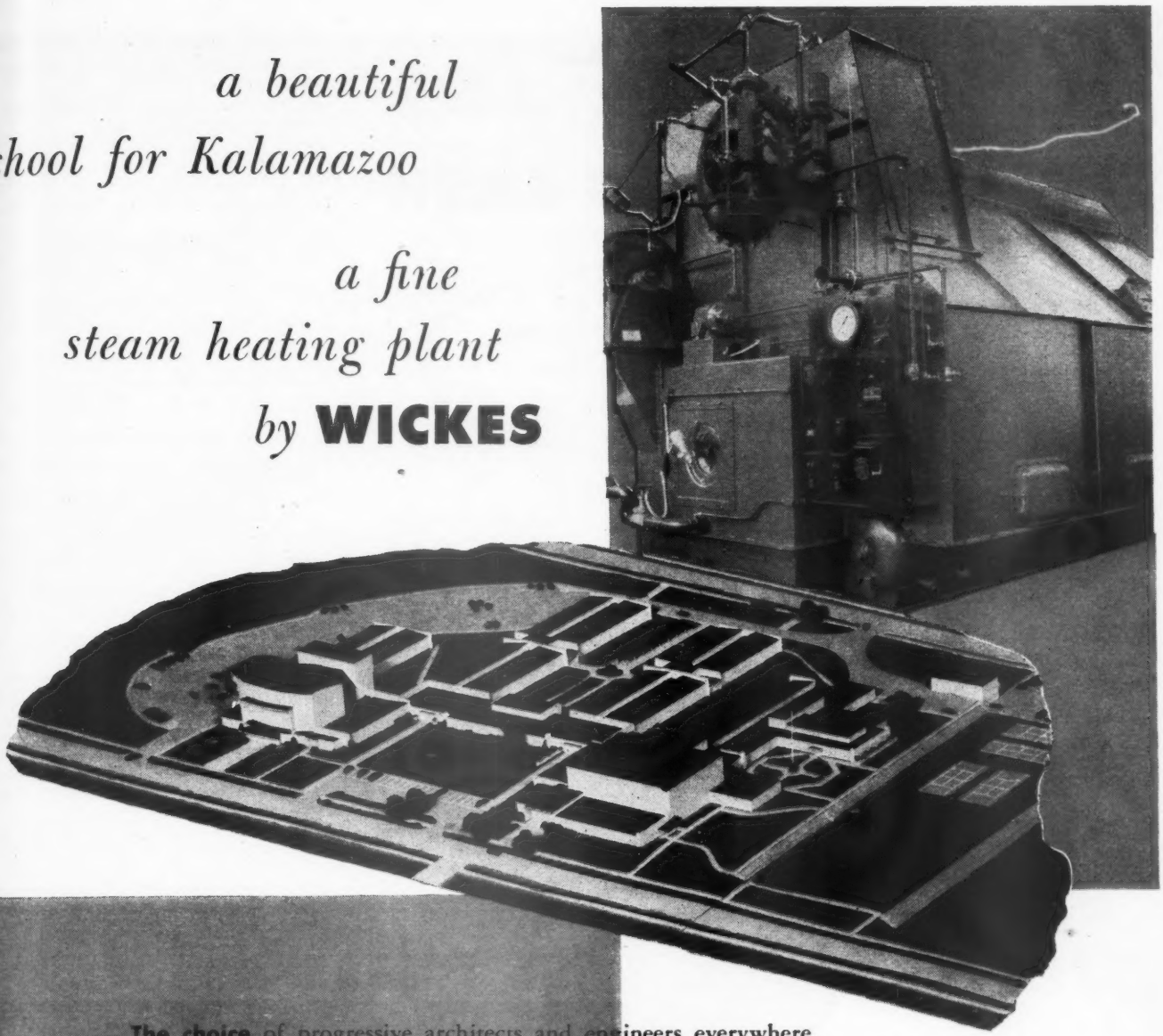

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(Continued from Page 18)

June 4-9—SAE, Summer Meeting, French Lick Springs Hotel, French Lick, Indiana.

June 8-10—National Oil Scouts and Landmen's Assn, Oklahoma City, Okla.

June 12-16—ASME, Oil and Gas Power Division, Lord Baltimore Hotel, Baltimore, Md.

June 12-16—AIEE, Summer and Pacific General Meeting, Huntington Hotel, Pasadena, California.

June 15-16—Pennsylvania Grade Crude Oil, Annual Meeting, Hotel William Penn, Pittsburgh, Penn.

June 18-20—Petroleum Equipment Suppliers Assn, The Greenbrier, White Sulphur Springs, W. Va.

June 19-23—ASME, Hotel Statler, St. Louis, Mo.

June 20-24—Canadian Gas Assn, Annual Meeting, Manoir Richelieu, Murray Bay, Quebec, Canada.

June 26-30—API, Production Division, Mid-Year Standardization Conference, Brown Palace Hotel, Denver, Colorado.

Aug. 14-16—SAE, West Coast Meeting, Biltmore Hotel, Los Angeles, Calif.

Sept. 5-9—National Chemical Exposition, Chicago Section, American Chemical Soc., Coliseum, Chicago, Ill.

Sept. 11-13—Oil Industry Information Committee, Hotel Traymore, Atlantic City, N. J.

Sept. 13-15—National Petroleum Assn, Hotel Traymore, Atlantic City, N. J.

Sept. 18-22—Instrument Conference and Exhibit, Instrument Society of America, Memorial Auditorium, Buffalo, New York.

Sept. 25-27—ASME, Petroleum Mechanical Engineering Division, The Roosevelt Hotel, New Orleans, Louisiana.

Oct. 2-6—AGA, Annual Convention, Atlantic City, N. J.

Oct. 2-6—Mid-Continent Oil and Gas Assn, Louisiana-Arkansas division, The Roosevelt Hotel (tentative), New Orleans, La.

Oct. 4-5—Mid-Continent Oil and Gas Assn, Texas Division, Baker Hotel (tentative), Dallas, Texas.

Oct. 9-10—American Assn of Oilwell Drilling Contractors, Annual Meeting, The Mayo, Tulsa, Okla.

Oct. 23-27—AIEE, Fall General Meeting, Skirvin Hotel and Skirvin Tower Hotel, Oklahoma City, Okla.

Nov. 9-10—SAE, Fuels and Lubricants Meeting, The Mayo, Tulsa, Okla.

Nov. 13-16—API, Annual Meeting, Biltmore Hotel and Ambassador Hotel, Los Angeles, Calif.

1951

May 28-June 6—World Petroleum Congress, The Netherlands, The Hague.

NOMADS MEET

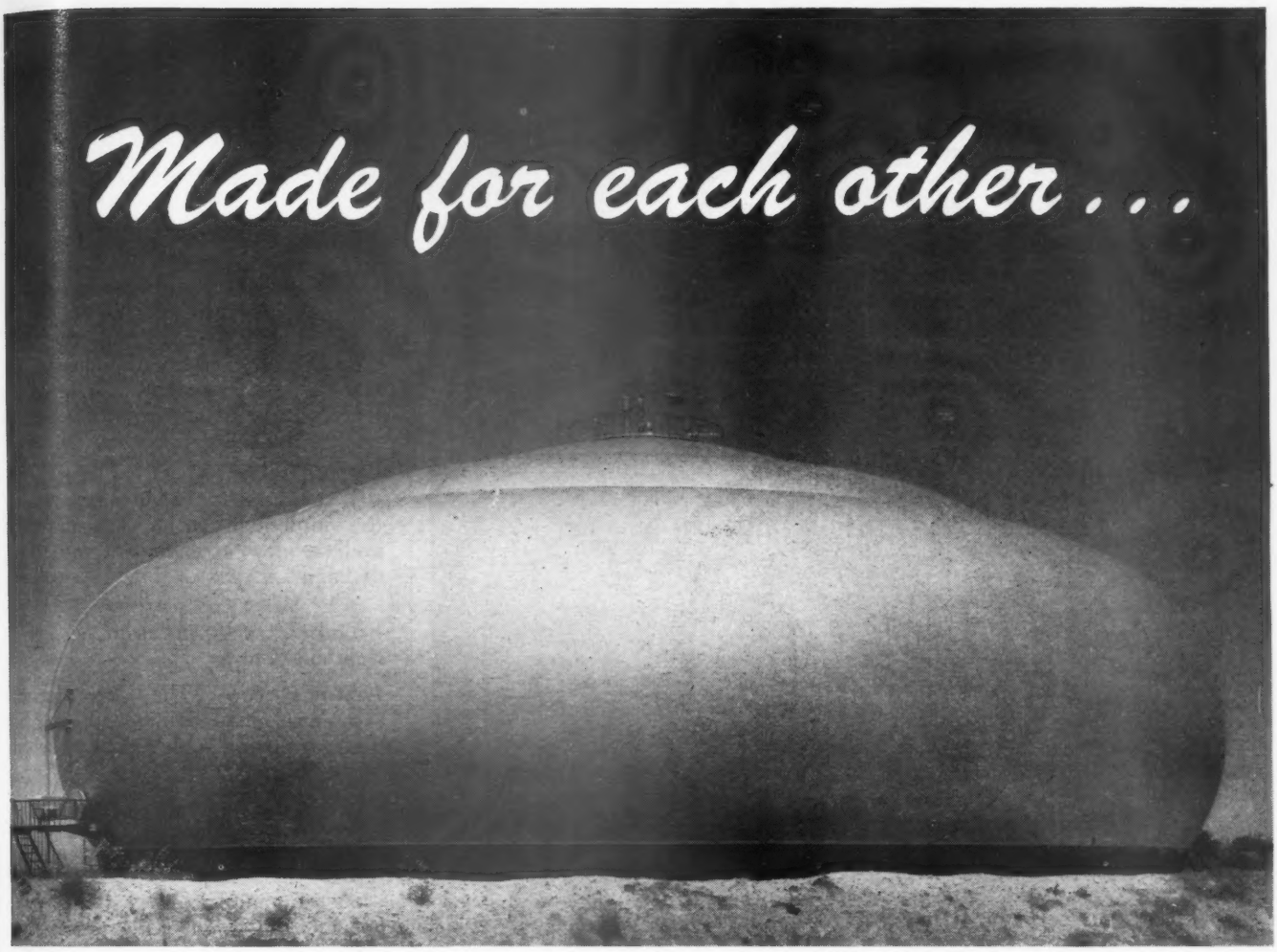
New York, N. Y., Chapter, First Monday of the Month, Louis Sherry's, New York, N. Y. Sec. Russ V. McIntire, 11 West 42nd Street, New York 18, New York.

Houston Chapter, Second Monday of the Month, Ye Ole College Inn, Houston, Texas. Sec. Harry E. Estes, P. O. Box 9321, Houston 11, Texas.

Los Angeles Chapter, Second Wednesday of the Month, Jonathan Club, Los Angeles, Calif. Sec. John W. Rife, 5905 Pacific Blvd., Huntington Park, Calif.

Tulsa Chapter, Third Wednesday of the Month, Hotel Tulsa, Tulsa, Okla. Sec. G. W. Davidson, Jr., Box 1188, Tulsa, Okla.

Dallas Chapter, Dallas, Texas, First Monday of the month. Sec. C. J. Berlin, P. O. Box 2968, Dallas, Texas



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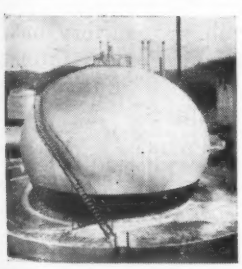

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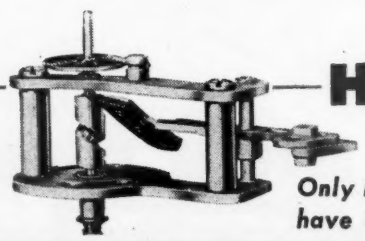

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LETTERS
to the Editors

Decimal Index System

To The Petroleum Engineer

I would like to know if there is a book published containing the complete decimal system of indexing devised by Professor L. C. Uren, of the University of California. If such a book is available, please advise where I may obtain a copy.

I would like to take this opportunity to compliment you on your magazine and the new arrangement into three divisions.

B. Oliver Wood

Brundred Oil Corporation,
Rantoul, Kansas

Editor's Note: The Uren decimal system is out of print at present but plans are being made for republishing in the future.

Tear Sheets

To The Petroleum Engineer

As a student on the way to graduating in Civil Engineering at the University of Genova, I am working at a report on "Processes of Underground Impermeabilisation and Solidification."

For the sources I have had a great help from the American Water Works Association of New York; but unfortunately I have not been able to find the December, 1943, issue of *The Petroleum Engineer*, in order to study an article concerning the "Use of Plastics in Water Control," by D. G. Hefley and P. H. Cardwell.

You will oblige me very much if you will send me some information.

Enrico Bussetti

Viale Mangiagalli, 3
Salice Terme (Pavia)
Italy.

To The Petroleum Engineer

We have read with interest in your May, 1949, issue an article beginning on page C-32 entitled, "Mechanical Removal of Entrained Materials from Natural Gas," by Frank H. Dotterweich.

We would appreciate receiving three copies of this article if they are available from your tear sheet files.

Harold W. Danser

President,
Ultrasonic Corporation,
Cambridge, Massachusetts.

THE Petroleum Engineer

FEBRUARY
1950

Petroleum Conditions in the Middle East*

CAMPBELL OSBORN[2, 3]

DURING the past three years the oil producing fields of the Middle East, that is, the fields of Iran, Iraq, Saudi Arabia (including Bahrein Island and the Sheikdoms of Kuwait and Qatar) supplied 25 per cent of Europe's requirements. These fields are illustrated by the accompanying map designated Fig. 1. In a few years these fields and new ones that will be discovered in this part of the world will supply nearly all Europe's needs. Increasing quantities of oil are being shipped to the Far East. What effect will this have upon the American petroleum producer?

Sales of crude oil from Middle Eastern countries to the East Coast of the United States were about 20,000,000 bbl in 1948, and 40,000,000 bbl in 1949. The main sources were Saudi Arabia and Kuwait. Will this increase of 100 per cent a year go on?

Look at the reserve picture. In 1944 E. DeGolyer, an eminent authority on oil geology, reported that the proved and indicated reserves of the Middle Eastern province were of the order of 26,800,000,000 bbl. The greater part of this reserve was discovered by means of only 100 test wells during the five year period ending in 1940, at which time, for strategic reasons and because of the shortage of materials, there was a cessation of drilling. In 1945 drilling was resumed, and as pointed out in subsequent sections of this discussion, although there has been no major addition to the known geology, the proved reserves have been greatly increased.

Compare these reserve figures with those for the United States and Venezuela. About 25,000,000,000 bbl was regarded pretty generally as the amount of recoverable proved unmined oil in the States at the beginning of 1949. The corresponding figure for Venezuela was 9,500,000,000 bbl. But we produced 7 per cent of our reserves in 1949, Venezuela 5 per cent of hers, and the Middle East only 1.5 per cent of theirs. America for many years has supplied about 60 per cent of the world's markets, including her own. Obviously this cannot go on unless we find large new reserves. We could probably do this, but it would mean a higher price structure to stimulate the necessary testing. As recently stated by Frank Abrams, chairman of the Jersey board, "Europe must look to the Middle East because the United States is using more of its own and South American production to meet domestic needs." We have long consumed more oil than we have produced. Our exports are not large in comparison with our domestic use. Certainly if we wish to conserve our oil resources, what Abrams says is desirable, but how is it going to affect the welfare of the thousands of producers of crude petroleum in the United States? Is it not conceivable that in the not far distant future the United States may have to look beyond Venezuela to the Middle East for a large part of its domestic requirements?

The most significant change in the petroleum industry during the past decade has been the steady climb in the production of crude petroleum in the Middle Eastern countries. Every single country reached new highs in 1949. Their combined yield last year was 1,367,000 bbl a day. The gain has been at an accelerated pace during the past few years. It was 20 per cent in 1949 over 1948, 36 per cent in 1948 over 1947, and 19 per cent in 1947 over 1946. These countries supplied 5 per cent of the world market in 1944, 12 per cent in 1948, and nearly 15 per cent in 1949. In the United States production declined nearly 10 per cent in 1949. In Venezuela production de-

[1]This is the last of a series of three articles by the author on China, Japan, and the Middle East. The first two have already been published. He has recently returned from a period of three years work in the Orient, first in charge of the manufacturing industries of Japan on General MacArthur's staff, second the responsibility for Paul Hoffman's oil program in China amounting to $50,000,000, and finally as an observer on his own behalf of conditions in the Middle East on his way home. Prior to the war the author was an advisor to a major American oil company and an owner of oil interests in the Mid-Continent.

[2]Consulting Industrial Engineer, Woodward Building, Washington, D. C.

[3]Credit is due to Andre Chang, petroleum technologist, U. S. Army of *Occupation in Japan, for assistance in the preparation of this article.*

EXCLUSIVE

clined nearly 30 per cent in 1949. (See Fig. 2.) What will the percentage of the world's markets supplied by the Middle Eastern countries be in 1960? Is the center of gravity of the world's crude supply shifting from the Atlantic, Gulf, and Caribbean region to the Middle East, as DeGolyer predicted in 1944?

The beginning of the developments that have brought about this major change in the sources of the world's oil supply was in Iran (then Persia) many years ago. The oil concession there has long been owned by one company, the Anglo-Iranian Oil Company, Ltd. At first the progress of drilling and refinery construction was slow. The oils had to be shipped by tanker all the way around Arabia to Europe and the European markets then were much smaller than they are now. That is true at the moment, so far as the Persian Gulf area is concerned, but they were able to compete with our refineries then and they can do it now. In the years that have elapsed since then some other British companies, a British-Dutch company, a French concern, and some strong American corporations have appeared on the Middle Eastern scene, opened new prolific fields in other countries, and built pipe lines to the Mediterranean Sea. This shortens the haul and greatly reduces the cost of transportation. It will not be long before a pipe line outlet from the Persian Gulf to the Mediterranean Sea will be in operation. This is just a beginning. Other long Trans-Middle Eastern pipe line systems connecting the Persian Gulf with the Mediterranean Sea are projected. As a matter of fact, one of the greatest programs of oil field development and trunk pipe line construction in the history of the petroleum industry is planned and under way. The quality of the oil is high. The wells are not deep or numerous. Their potentials are large. As competitive drilling is not a factor to be reckoned with, the fields are handled with consummate engineering skill, contributing to low lifting costs and high ultimate recoveries. When the transportation bottleneck is removed how high and how rapidly Middle Eastern production will rise is anybody's guess. For these reasons and others that will be explained hereafter, despite the political uncertainties, the cost of the concessions, the high royalties, and the unusual expenses involved in foreign operations, this great new supply of oil will be produced at costs lower than in the United States. The companies that control the Middle Eastern fields are primarily interested in making money in the refining and marketing of petroleum products. The effects upon the American petroleum industry will be far reaching.

The refining capacity in the Middle East is about 800,000 bbl per day. Of this 780,000 is in the Persian Gulf region. The only large plant in the eastern Mediterranean area is that of the Iraq Petroleum Company, Ltd., at Haifa, Palestine, with a capacity of 90,000 bbl per day. Products made in this plant have a transportation advantage over products made in America. The difference between the present daily production of approximately 1,367,000 bbl per day in all the Middle East and the combined capacity of the Persian Gulf and Haifa plants, or about 587,000 bbl per day, is crude moving out by tanker. But let us look at the facts more minutely.

The Situation in Iran

Certainly the oldest, and doubtless one of the most important sources of crude oil from the Middle East is Iran. Commercial oil production in the Middle East began in the Masjid-i-Sulaiman field in 1908. It was light oil and was found at the shallow depth of 1180 ft. The exclusive right to produce petroleum in Persia had been granted in 1901 to D'Arcy. It covered the full extent of the then Persian Empire. Subsequently the Anglo-Persian Oil Company, Ltd. (now the Anglo-Iranian Oil Company, Ltd.) was formed and the concession was transferred to them. The concession now covers 100,000 sq miles and will not expire until 1993. The ownership is entirely British. Of the stock outstanding, the British Government owns 56 per cent, the Burmah Oil Company, Ltd., 22 per cent, and the British public the remainder.

Additional drilling in the discovery field proved highly successful. In 1916 a 10-in. pipe line was completed from the field to Abadan, only 130 miles distant at the head of the Persian Gulf. A small refinery (now the largest in the world) was built at Abadan.

Further tests at great distances, so far as oil exploration is concerned, to the northwest and southeast of the discovery pool, yielded new fields. In 1923 the Naft-i-Shah field came in. At the beginning of 1948 it was yielding 3000 bbl per day. By this time the discovery pool was yielding 73,000 bbl per day. In 1928 Haft Kel was discovered. At the beginning of 1948 it was yielding 197,000 bbl per day. In 1938 came Gach Saran, Naft Safid, and Agha Jari, producing at the opening of 1948 about 38,000, 17,000, and 144,000 bbl per day respectively. All this came from only 71 wells.

Daily average production of all these fields, which the company was able to tap without extensive pipe line construction, at the beginning of 1948 was 472,000 bbl per day; during 1949 550,000 bbl per day. And a new pool was brought in in 1946 at Lali to the northwest of the discovery field that awaits adequate pipe line facilities to test its potentialities.

The original pipe line to Abadan had a capacity of 80,000 bbl per day. Several extensions, made between 1929 and 1946, of less than 200 miles each in length, now serve the other pools. The combined pipe line capacity is about 550,000 bbl per day.

The refinery at Abadan has been expanded from time to time until it now has a basic crude still capacity of half a million barrels per day, and cracking capacity of 125,000 bbl per day. It has been operated most of the time at nearly its full capacity in order to supply Britain's important European and small Middle Eastern, Oriental, and East African markets. During the war a 100 octane gasoline plant was built. The refinery as a whole is and was primarily a topping and cracking installation, but recent additions have been made to include small lubricant and catalytic cracking departments.

The Kermanshah Petroleum Company, a subsidiary concern, owns and operates a 2000 bbl plant at Kermanshah to process crude produced locally from the small field called Naft-i-shah.

To date the Anglo-Iranian Oil Company, Ltd., has not been a large marketer of crude petroleum. During 1948 they shipped a small quantity to the Chinese for processing in the Formosan plant of the Chinese Petroleum Corporation, and they are now actively seeking markets for crude in Japan. They sold about 6,000,000 bbl of crude to the East Coast plants of the United States in 1948 and 1949.

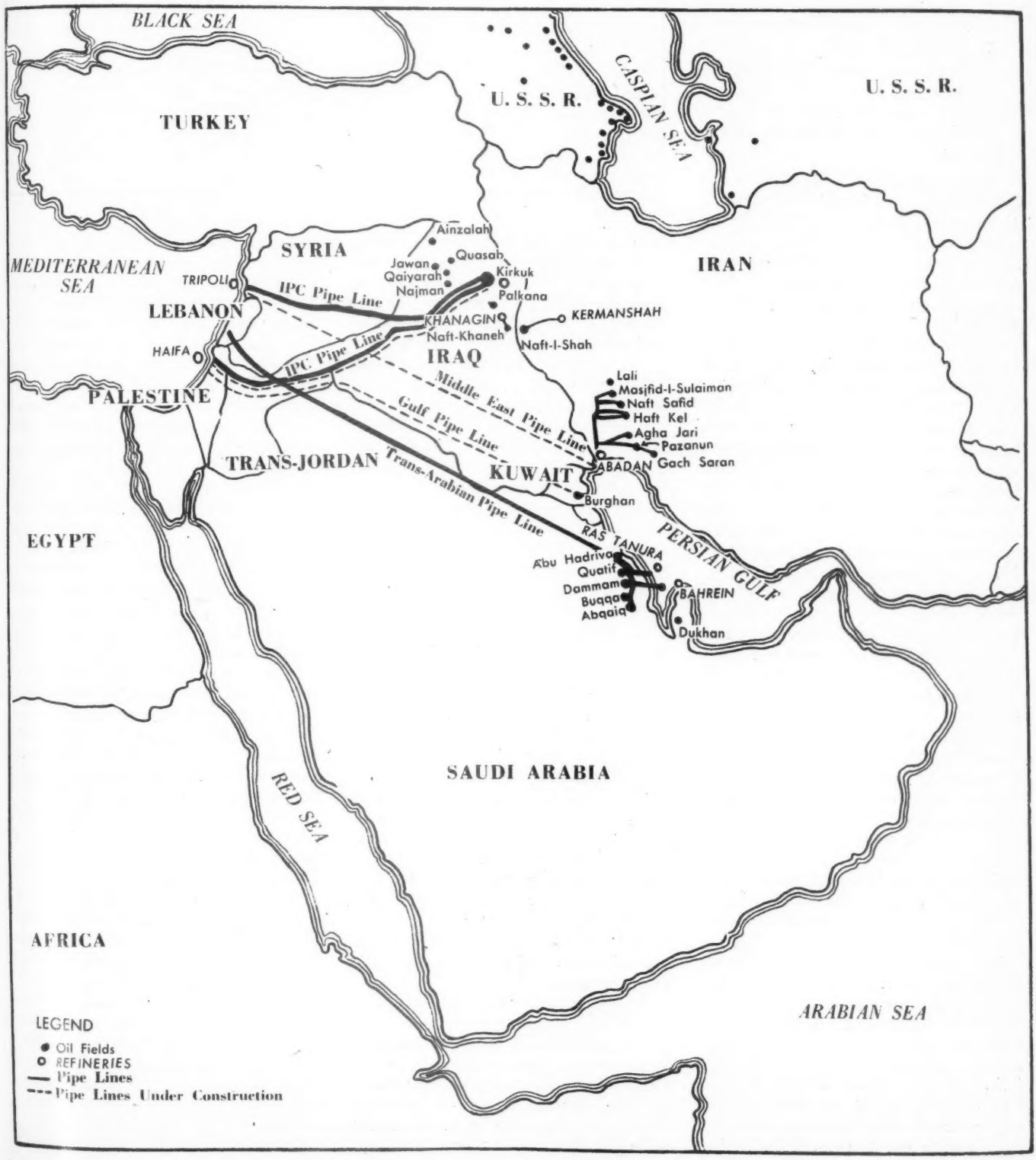
DeGolyer in 1944 credited Iran with a proved reserve of 6,500,000,000 bbl. This will last a long time at the rate of production of 200,000,000 bbl in 1949. The productive areas in the aggregate amount to about 134,000 acres. Depths to tops of producing zones vary from 600 to 4500 ft. Thickness of producing zones range from 250 to 1500 ft, with most of them over 1000 ft. The total number of producing wells is less than 100, but it has paid the company to drill nearly 50 observation wells.

On January 1, 1948, 29 wells in the Masjid-i-Sulaiman pool were producing 73,000 bbl per day, in the Haft Kel pool 23 wells were yielding 197,000 bbl per day, and in the Agha Jari pool 12 wells were producing 144,000 bbl per day. Yields of this volume

from such a limited number of wells are unknown outside of the Middle East. The maximum number of wells producing simultaneously in the Masjid-i-Sulaiman field has been 31. The number of test wells and dry holes that have been drilled in Iran is comparatively small. In 1948 only 15 strings of tools were operated in the entire country. It is unnecessary to point out in detail the extent to which good production engineering is being applied in these fields, nor how the natural gas that accompanies the oil is being fully utilized to lift it, nor how the water level in the producing zones is being carefully controlled. It is well summarized by C. T. Barber, of the *Petroleum Times*, London, England, in the following language:

"In this technique two principles are fundamental: The maintenance of a uniform rise of the water level throughout the entire reservoir; and the maintenance of bottom hole flowing pressure safely above the bubble point of the crude so that no free gas is drawn into producing wells. These objectives involve a strict control of pressure and the use of observation wells for the continual check of gas dome pressures, and gas/oil and oil/-water levels throughout the reservoir."

FIG. 1. Middle East oil fields, refineries, and pipe lines.



The Situation in Iraq

Although more complicated by the position of the oil fields remote from tidewater, the situation in Iraq is not dissimilar from that in Iran. The oil fields are situated in the northeastern part of the country between southeastern Turkey and northwestern Iran. Concessions for oil exploration and production have been granted for the entire country. For the purpose of classifying these concessions and identifying the ownership Iraq may be divided into three districts as follows:

A. The Baghdad area east of the Tigris River and Mosul region in the same area.

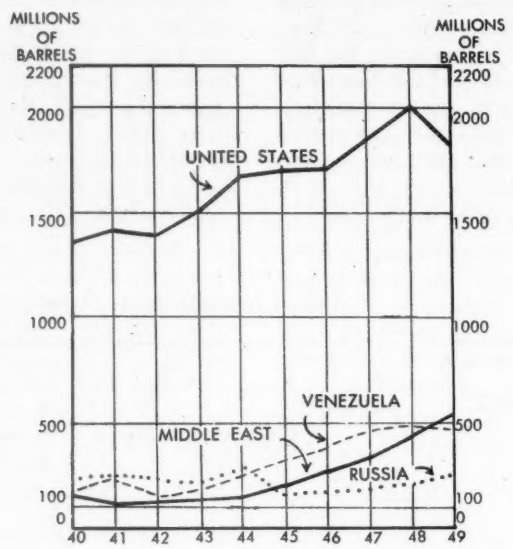
B. The region west of the Tigris River.

C. The southern part of Iraq known as the district of Basrah.

With respect to the duration of the concessions, each is valid for 75 years, in the order given, from 1925, 1932, and 1938 respectively. Three companies with the same ownership and control have these concessions. The companies are chartered in Great Britain. The original concession to District A dates back to a grant made by the Turkish Empire to an English and German syndicate before the first World War. The present owner is the Iraq Petroleum Company, Ltd. The original concession to District B was made to the British Oil Development Company, but is now owned by the Mosul Petroleum Company, Ltd. The concession to District C is owned by the Basrah Petroleum Company, Ltd. These are the operating companies. The ownership of 95 per cent of the stock in these companies is British, Dutch, French, and American. The Anglo-Iranian Oil Company, Ltd., and Royal Dutch Shell own 47.50 per cent. A French company, The Campagnie Francaise des Petroles, owns 23.75 per cent. The Near East Development Company, owned by The Standard Oil Company (New Jersey) and the Socony Vacuum Oil Company, hold 23.75 per cent. C. S. Gulbenkian, a native of Armenia, who took a prominent part in the original negotiations with the Turkish Gorvernment, and who is said to have a broad knowledge of the disposition of royalty oil over past years, owns 5 per cent.

The main production in Iraq is in the Kirkuk pool of District A not far north of the confluence of the Tigris and Little Zab Rivers. The first important well came in in October, 1927, with an estimated potential of 80,000 bbl per day, at about 1500 ft. The oil had a gravity of 36 deg API. At the beginning of 1948 there were 31 producing wells and 48 observation wells.

FIG. 2. Main oil-producing countries.



Considerable new drilling was done in 1948 and 1949, but production has been limited by the pipe line capacity from the field. In 1940 the yield was 49,000 bbl per day. In 1949 about 84,000 bbl per day were produced.

The shallow production found in the four fields south of the city of Mosul in District B has been heavy oil with a gravity of 16 deg API and is used for local consumption only. The first important well was completed at Qaiyarah in October, 1927, at 780 ft, with a yield of 4000 bbl per day. Seventy wells have been drilled in these four fields. In 1939 some 32 gravity oil was found in the Ain Zalah pool about 60 miles northwest of Mosul at 5000 to 6000 ft, but it is a long distance from the pipe line system that serves the prolific Kirkuk field.

The most interesting new spot is near Basrah in southeastern Iraq not far from Abadan across the boundary in Iran, to which drilling equipment was moved from Ain Zalah in 1942. This is in District C. The objectives are to determine whether the prolific sands in the Burghan pool 80 miles to the south in Kuwait, or the Jurassic sediments productive in Saudi Arabia farther to the southeast can be found. The results of the new drilling here were encouraging in 1948 and 1949 and it is believed that further tests in 1950 and 1951 will add substantially to the proved reserves of Iraq.

At the beginning of 1948 there were two 12-in. pipe lines that transported crude petroleum from the Kirkuk pool to the eastern Mediterranean. The terminus of one was in Palestine at Haifa and the other at Tripoli in Lebanon. These lines are some 500 to 600 miles in length. They are inadequate to handle the amount of oil that could be produced from this field. Early in 1948 duplicating 16-in. lines were being constructed to Haifa and Tripoli and additional lines were planned that would have more than doubled the capacity, but the work on the Haifa line was stopped by the political and military turmoil that flashed up in 1948 in this region of ancient rivalry between the Jew and the Arab. It had been planned to complete the Haifa line in 1949 and the Tripoli line in 1951. The Tripoli line was completed in 1949 and provided an additional outlet, but the Haifa line is still shut down.

The only other oil developments in Iraq is at Naft Khaneh in the eastern part of the country. Here the Anglo-Iranian Oil Company, Ltd., subsidiary, the Khanaqin Oil Company, produces a small amount of oil and refines it in a 6500 bbl plant at Khanaqin. Other than this there are no petroleum refineries in Iraq unless the stabilization installation of the Iraq Petroleum Company at Kirkuk, which was used for topping purposes during the war, be so considered. Most of the Kirkuk oil is refined in a 90,000 bbl plant at Haifa operated by the Consolidated Refineries, Ltd., a joint enterprise of the Anglo-Iranian Oil Company, Ltd., and the Anglo-Saxon Petroleum Company (Shell) and sold mainly in the European market. As Iraq production increases this plant will doubtless be enlarged. There is a small plant at Tripoli owned by the Iraq Petroleum Company that was shut down during the war, and with the expansion of Iraq crude production refining facilities at this point will no doubt be increased.

DeGolyer in 1944 credited Iraq with

a proved reserve of 5,000,000,000 bbl. The main reserves are in the Kirkuk field where the oil bearing zone is 1000 ft in thickness and extremely fractured. The salt water underlying the oil is kept at a uniform level. There is good communication throughout the entire reservoir and the decline of pressure is uniform. The producing area is eight miles long and it is believed this may be extended not less than two miles.

About a million barrels of crude petroleum were shipped to the East Coast of the United States from Iraq in 1948 and 1949.

The Situation in Saudi Arabia

(Including Bahrein Island and Qatar)

The development of the oil fields on the mainland of Saudi Arabia, and in Bahrein Island and the Peninsula of Qatar, two independent sheikdoms, has been greatly simplified by their proximity to tidewater. There are four near the coast of Saudi Arabia proper midway between the head and mouth of the Persian Gulf. One is in the center Bahrein Island, and another is on the west side of Qatar. As in the case of the properties of the Anglo-Iranian Oil Company, Ltd., they would have been more rapidly exploited had it not been necessary to ship most of the oil by long haul around the big Saudi Arabian peninsula to reach the markets of Europe. The Trans-Arabian pipe line from Dhahran in the center of the Saudi Arabian fields to the Levant Coast of the Mediterranean will solve the major part of this important problem.

The right to explore for and produce oil in an area of approximately 440,000 sq miles in northern, eastern, and southern Saudi Arabia is owned by the Arabian-American Oil Company, a 100 per cent American concern. The concession expires in 1999. The original concession was obtained by the Standard Oil Company of California. At the beginning of 1948 the Arabian - American Company was a joint enterprise of the Standard Oil Company of California and the Texas Company. At present the Standard Oil Company of California, the Texas Company, and the Standard Oil Company (New Jersey) each owns 30 per cent of the stock and the Socony Vacuum Company owns 10 per cent.

The original concession was dated in 1933. Geological exploration and test drilling went on for six years before the prolific Dammam pool was discovered in 1938. By the beginning of 1948, with only 32 producing wells, it yielded 100,000 bbl per day. Then came the Abu Hadriya pool 100 miles to the northwest, which was a disappointment. In 1941 the great Abqaiq field was discovered, that by 1948, with only 18 producing wells, yielded 200,000 bbl per day. The Buqqa area with three wells in 1948 was an extension of this pool. Qatif was discovered in 1945. In 1948 the combined production of these fields was 375,000 bbl per day, in 1949 460,000 bbl per day. Most of this production is found above 7000 ft and many wells yield 10,000 bbl per day with little diminution.

The pipe lines serving these fields are short, the longest not over 60 miles. They were built between 1939 and 1948. They extend from Dhahran at the Dammam field of Ras Tanura, under water and overland from Dhahran to Bahrein, and from the Abqaiq field to Dhahran and Ras Tanura. They range in diameter from 10 to 30 in. The capacity of the line built from the Abqaiq field to Ras Tanura in 1948 was 326,000 bbl per day. The capacity of the lines from this field to Dhahran was 200,000 bbl per day. The capacity of the line from Dhahran to Bahrein was 117,000 bbl, and to Ras Tanura terminal and refinery 186,000 bbl. Construction was under way in 1948* in the Middle East of a 1000 mile 30 to 31-in. line from the Abqaiq field to Levant coast of the Mediterranean Sea with a capacity of 300,000 bbl per day, scheduled to be completed in 1949, but the work was suspended because of the political disturbances in Palestine. It has now been resumed. The owner of the line is the Trans-Arabian Pipeline Company, an American concern controlled by the same group of companies as the Arabian-American Oil Company. Another and larger line with a capacity of 500,000 bbl per day with a terminus in Syria is said to be projected for completion in 1952.

The Arabian-American Oil Company operates a refinery on Ras Tanura peninsula served by its own crude production and pipe lines with a capacity of 135,000 bbl per day. The products made are gasoline, kerosine, and diesel and fuel oils.

Marketwise the greater part of the crude oil produced by the Arabian-American Oil Company is processed in its refinery at Ras Tanura or in plants owned by the companies that own its stock. In 1948 it sold over 100,000 bbl per day of crude to the Bahrein Petroleum Company for processing on Bahrein Island and about 10,000 bbl per day to the Chinese Petroleum Corporation for processing in its Formosan plant. The foreign marketing affiliates of this group are probably the most aggressive in the petroleum industry and they are selling ever increasing amounts of Saudi Arabian crude and finished products throughout Europe, South America, Africa, and Asia.

In 1944 DeGolyer estimated that the fields of Saudi Arabia were capable of yielding 5,000,000,000 bbl of oil. This was before the discovery of the Qatif pool in 1945 and the Buqqa extension to the Abqaiq field in 1947. Since DeGolyer wrote his report, a number of additional wells have been drilled in the Abqaiq pool that add to its reserves. The Buqqa extension is 20 miles from the Abqaiq field and it is not unlikely that the area between them will be productive. Many geologists believe that DeGolyer's estimates, in the face of these developments, are extremely low. Dammam production is found at 4500 ft and the thickness of the producing zones is 300 to 400 ft. The structure at Abqaiq is an anticline 14 miles long and 5 to 6 miles wide with a 1400 ft closure at the top of the lowest producing formation.

During 1948 and 1949 Saudi Arabia shipped 30,000,000 bbl of crude petroleum to the East Coast of the United States. Socony-Vacuum and Standard Oil Company (New Jersey) each use an average of about 50,000 bbl per day and plan to increase their takings.

The development of the one oil field in Bahrein Island, owned by Bahrein Petroleum Company, Ltd., chartered in Canada, though precedent to the discovery of oil in the neighboring Saudi Arabian fields, has been more or less coincident with their development. In fact, the ownership is the same. Fifty per cent of the stock of the Canadian company is owned by Standard Oil Company of California and 50 per cent by the Texas Company. The original concession was obtained by an English group in 1925, but was assigned in 1930 to the present owners. It covers the entire Bahrein Archipelago, amounting to 100,000 acres, and expires in 1995. The Sheikdom of Bahrein is under British protection. Oil was discovered in 1932, the first in the southern part of the Persian Gulf area, drawing attention to the possibilities of the neighboring mainland. Surface geology was all that was needed to locate the Bahrein field. An eroded rim rock of limestone surrounds the entire field. There are three pay sands. Thickness of the oil bearing sections of the first and second pays is about 500 ft and the depths 1800 to 2300 ft respectively. The deepest wells are 4700 ft. The production in 1949 was about 30,000 bbl per day. DeGolyer estimated in 1944 that Bahrein Island was capable of producing 300,-

*When the author was in the Middle East.

000,000 bbl, based upon the geology and developments known at that time.

The Bahrein Petroleum Company operates a refinery close to the field with a capacity of 146,000 bbl per day. It processes the production from the local field and buys the remainder of its requirements from its sister company, the Arabian-American Oil Company. The plant is a modern topping and cracking installation with both thermal and catalytic facilities.

The marketing problems of this company gave rise in 1936 to the formation of the California Texas Oil Company, Ltd., known to the trade as Caltex. As in the case of the Bahrein Petroleum Company, Ltd., the ownership is vested in the Texas Company and the Standard Oil Company of California. It first took over the handling and marketing facilities of the Texas Company in Africa, Asia, and Australia. Subsequently it bought the properties and good will of a company with extensive marketing facilities on the continent of Europe, in Great Britain, and in the Mediterranean region. It is the most active company in the Orient and its coverage includes practically the entire Eastern Hemisphere.

There is one oil field in the Sheikdom of Qatar, a peninsula lying just south of Bahrein Island, under British protection. It is called the Dukhan pool. In 1935 the Sheik of Qatar granted an exclusive concession for producing oil throughout all his domains, amounting to 4000 sq miles, to the Petroleum Development Company (Qatar), Ltd., a British concern. This company is owned by the Petroleum Concessions, Ltd., and Petroleum Concessions, Ltd., is owned by the same group that owns the Iraq Petroleum Company previously discussed. (There certainly are a lot of interlocking ownerships in the Middle East oil industry.) The first well was completed in 1940 with a potential yield of 5000 bbl. The following year a second well 10 miles south came in with the same result. The third well 2½ miles east of the first encountered water. There were no pipe lines and drilling was suspended during the war. On the basis of the information revealed by this drilling and the geological work done, geologists credited the field with a reserve in 1944 of 1,000,000,000 bbl. After the war drilling was resumed in the north end of the field with good results that now make DeGolyer's estimates look ultra-conservative.

The Situation in Kuwait

Probably the most active area in the Middle East at this time is the Burghan field in the small Sheikdom of Kuwait, lying between Iraq and Saudi Arabia at the head of the Persian Gulf. It is under British protection. The concession was granted to the Kuwait Oil Company, Ltd., in 1934. It comprises the entire area of the country amounting to 6000 sq miles, and expires in A. D. 2009. The company is chartered in Britain, but the Gulf Exploration Company, an American corporation, owns one half of the stock. The other half is owned by the Anglo-Iranian Oil Company, Ltd.

After geological and geophysical surveying and an encouraging test hole at Bahrah north of the city of Kuwait a discovery well yielding commerial production was completed south of the city in 1938 at 3672 ft. Eight more wells were put down between 1938 and the suspension of drilling due to the war. These wells were plugged with cement for the duration of the war. In October, 1945, the wells were opened and put on production. Ten additional wells were completed between that date and the end of 1948 and there was much drilling in 1949, spectacularly increasing the production and materially adding to the proved reserves. Properly to describe the situation at Kuwait requires the use of superlatives. It is the world's largest individual oil field. In 1944 competent geologists estimated its proved reserves to be 9,000,000,000 bbl. The yield in 1948 was 130,000 bbl per day. Now it is 250,000 bbl. The field covers over 30 sq miles. The shallowest production is at 3600 ft and the deepest less than 5000 ft. At the center of the structure the producing zones are 1100 ft in thickness. The wells are pinched in to produce 5000 to 6000 bbl each. The oil is 36 deg API. A dozen or more rigs are in operation.

The production of the field is severely handicapped by lack of pipe line facilities. Tank farm storage and field gathering systems were first built and then a pipe line to the Persian Gulf at Fahahil was constructed in order to provide water transportation of the crude to refining points. In 1947 the Shell Petroleum Company entered into a contract with the Gulf Exploration Company, owner of a one-half interest in the Kuwait Oil Company, Ltd., to purchase annually expanding volumes of the crude from this field over a considerable period of years. This was probably an effort on Shell's part to bolster their Far Eastern markets that the Japanese occupation of the East Indies impaired and to reduce the burden upon their sources of petroleum in North and South America. Crude shipments to Europe in 1948 were running at the rate of about 100,000 bbl per day. The British and American occupation zones of Germany took about 2,000,000 bbl of crude from Kuwait and Saudi Arabia during the past two years. Shipments of crude to the East Coast of the United States exceeded 20,000,000 bbl in 1949.

Although Kuwait is well located to supply the Far Eastern market, this market is limited and the future prospects for Kuwait crude lie to the west. In other words, the Kuwait Oil Company, Ltd., has the same transportation problem as the Iraq Petroleum Company, Ltd., the Anglo-Iranian Oil Company, Ltd., and the Arabian-American Oil Company.

Two major pipe line systems were projected in 1948 to solve this problem. One was a line to be built jointly by the Gulf and Shell groups from Kuwait across Iraq and Trans-Jordan to the coast of Palestine. The length of this line would be 1000 miles. The proposed capacity was 3,000,000 bbl per day, as reported in the petroleum press, and the scheduled date of completion 1955. Capacity for 200,000 bbl per day was to be completed in 1948, 120,000 in 1949, and additional increments each year thereafter until the entire plan was completed. The line was to be named the Gulf Pipe Line. Another was a project by Anglo-Iranian Oil, Standard Oil (New Jersey), and Socony Vacuum to construct a 34-36-in. line from Kuwait via Abadan, Iran, Iraq, and Syria to Tripoli in Lebanon. This, to be called the Middle East Pipe Line, was to have a capacity of about 500,000 bbl. The interests involved later proposed to build, under the name of the Kuwait East Pipeline Company, a 34-36-in. line to the Mediterranean Sea with a capacity of 300,000 bbl per day to be completed in 1953. Projects of this magnitude are always tentative, depending upon crude supply and market requirements, but in this instance they were also subject to being interfered with by diplomatic, political, and military considerations and by the inability to get line pipe. The pressure for a cheaper outlet for Middle East crude to the Mediterranean Sea will continue until some of these lines are built, and then there will probably not be enough modern refining capacity in Europe or elsewhere in the Mediterranean area to handle the potential new supply. Ultimately it will probably come to the East Coast of the United States in volumes that will have a permanently depressing effect upon the price of higher cost crude petroleum produced in this country. ***

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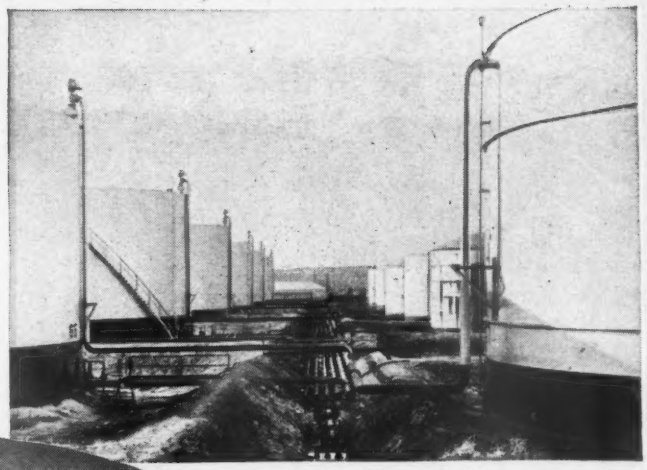

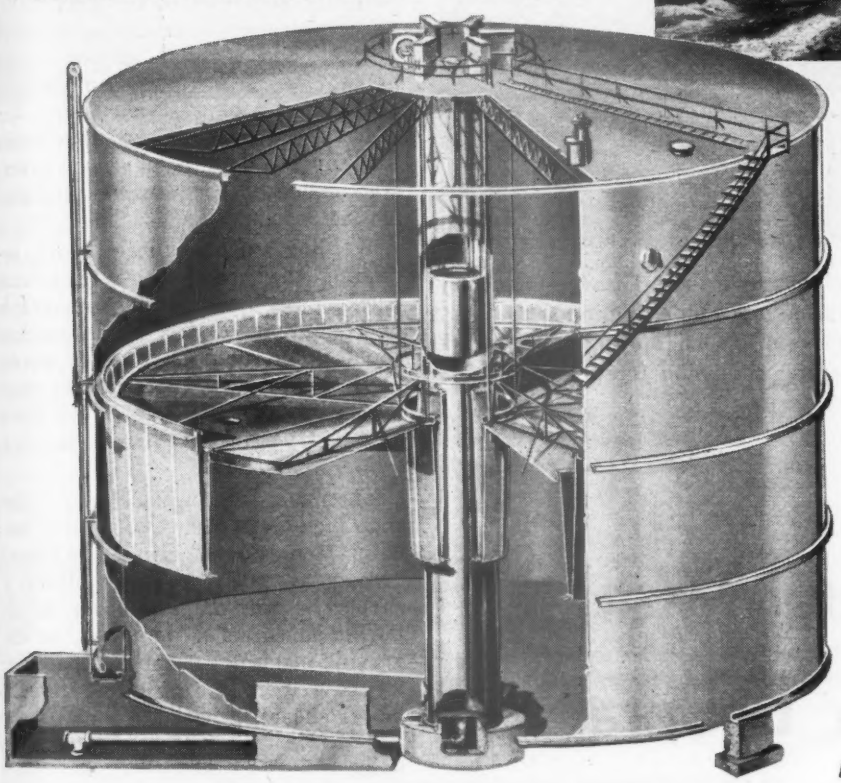

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Looking down the main floor of Gulf Research machine shop. Glassed-in rooms are clerical office, inspection shop, grinding room, paint shop, plating shop, and stock room. Most machines are faced the same way to facilitate supervision and enhance orderliness. Lee Fuhrman operates shaper in foreground.

Specialized Metal-Working Serves Research Laboratory

THE spectacular growth of industrial research during the past few years has made necessary the enlargement of many laboratory metal-working shops. Outstanding among those recently expanded is the new and modern machine shop of the Gulf Oil Corporation's research laboratories at Harmarville, Pennsylvania.

Dual Function

Planned to function 100 per cent as a "tool" for the oil firm's research and exploratory work, the shop is supplying all metal-working requirements of the laboratories' staff of chemists, physicists, and engineers. It also produces most of the parts required for geophysical prospecting equipment made by Gulf, and used in its exploration activities throughout the world.

By the very nature of the work, a great many of the parts specified by Gulf's research staff cannot be obtained in the open market. Requests usually are for "one-of-an-item" parts that can be made under closer supervision of the designer and frequently more quickly than if the work were given to job shops.

Products of the Gulf shop are extremely diversified, ranging from clocks for bottom hole pressure gages used in oil well drilling and production, to harvesters used to gather pyrethrum daisies for use in the company's insecticides.

Another important role of the shop is that of testing, cutting, and grinding oils. Products developed by the laboratories' lubrication division are evaluated here in both normal and special test machining operations.

The new Gulf machine shop has 18,479 sq ft of floor space. The main shop and assembly floor occupies 10,676 sq ft, and storage space in the basement and mezzanine consumes slightly more than 2500 sq ft. Supervisory offices and supplementary rooms occupy the remainder. The supervisory offices, along the building's south wall, are linked together with an intercommunication system that also is connected with the desks of the various foremen in the shop.

A grinding room, where a large part of the laboratories' testing of thread-grinding oils is conducted, is partially sound-proofed. Next to it, is a paint shop with explosion-proof fixtures and a high-suction spray booth. The electro-plating room has a tile floor, a blower vent system for removing fumes, and suitable baths for copper, nickel, chrome, silver, gold, cadmium, lead, tin, and indium-plating.

Welding and sheet metal work, including the manufacture of special truck bodies needed for seismograph operations, is carried out in another sound-proof room, next to the assembly bay. The stock room carries some 2600 different items, ranging from waxed paper to steel bars measuring 6 in. in diameter.

The metal-working machines of the shop include 24 lathes, 13 milling machines, 6 presses, 12 grinders, a thread grinder, 9 vertical drills, a planer, 2 shapers, a gear shaper, an horizontal-boring machine, a jig borer, an engraving machine, a nibbling machine, a spot welder, 2 arc welding units, 2 power shears, a brake, 5 metal saws, and miscellaneous small machine tools.

Basic Policies

The shop is operated as a responsibility of R. J. S. Pigott, director of the engineering division. It is under the immediate supervision of F. F. Versaw, superintendent. The basic policies responsible for its performance and efficiency have evolved as a result of trial and development since this type of work first was started at the laboratories in 1929.

Centralization

Centralization, or the grouping under one roof of all shop and allied services such as welding, painting, etc., is considered a major advantage over having individual and smaller shops assigned to laboratory departments. The shop floor proper has been arranged into three units of machines and benches. Each unit is similarly equipped and virtually is a complete shop in itself. Thus, on any job, the

Automotive equipment especially built for oil exploration. Chassis of a marsh buggy above is a huge-wheeled vehicle developed by the laboratory for prospecting work in swampy and flooded regions. Left to right are Francis Cunningham, Marcus Holpfer, Reed Henderson, and William Camelli.

Technical journals and reading table provide Gulf Research machine shop workers with a "library" which attracts considerable use. Left to right, machinists Edmund Weick, Kurt Nestel, Ralph Strohm, and William Jenkins catch up with the newest wrinkles of their trade during lunch hour lull.

machinists are only a few steps from their benches to any machine they might need.

The cost and accounting systems used in the machine shop of the Gulf Research Laboratories are completely detailed. A record for each job—no matter how small—shows total hours, the time the various machines used were operated, and the quantities and prices of material required. So complete are the records that each hour of every man and machine can be traced for the past seven years.

Mechanics with specialized ability are necessary for the type of work done in this shop. The experimental field is relatively narrow and men with the desired training and experience are so difficult to find that the laboratory has developed a program of training. Each selected trainee serves a 10,000-hour apprenticeship during which he does all types of work under the supervision and guidance of an expert craftsman. When his course is completed, he is a full-fledged journeyman schooled in all phases of his craft.

Products displayed on the table illustrate the diversified work of the Gulf Research machine shop. Among them may be noted seismograph detector parts, a crankshaft, pump gears, gravimeter, special cutters, geneva gears, piston. Facing camera, left to right, are Walter J. Schuster, assistant shop superintendent; Forest F. Versaw, shop superintendent, holding a film collector clamp; H. M. Peters, superintendent of construction and maintenance; and E. W. Jacobson, design engineer. Mechanics J. Koch and L. Soisson examine the bomb-like "bird."

Working Conditions

Sound-proofing of welding, grinding, and sheet-metal operations has reduced noise in the Gulf laboratory shop. Blasts of hot air during the winter season have been eliminated by monitor heating and wall radiators, with vents directed to the ceiling.

Daylight is provided by windows rising from bench level to ceiling on main floor and the entire height of the monitor section. To avoid sun glare and summer heat, all work benches have been placed on the shady side of the structure. Any artificial illumination that is required is provided by fluorescents.

The interior side walls are painted with two shades of green, while the end walls are of yellow. All hazards, including the overhead crane, are bright yellow. Lathes and other machines have been painted horizon gray or spotlight buff, and most face the same direction to facilitate supervision and enhance orderliness. * * *

Part 1

Significant Research in Petroleum Recovery

HARRY H. POWER*

ALTHOUGH scientific research enjoys a popular vote of confidence today which is useful in obtaining support for research, an obligation is imposed in choosing those projects which offer the best prospect of justifying this confidence. Fundamental research, having for its basis the reproducible experiment, is aimed at the acquisition of knowledge and understanding. It is the only tool we possess for extending our knowledge of the universe, and, accepted as the scientific method, it is applied to obtain a better understanding of our environment.[1] Whatever the motive which impels an individual to engage in scientific research, or an organization to support it, the primary goal to be attained would seem to be a better understanding of nature and of man. This knowledge should be applied intelligently and constructively in the evolutionary upgrading of society. The practical application of fundamental research is the ultimate long-range goal of all research, but it should not be either the goal or the impelling motive of *all* researchers, since the shortest route may lead through researches having no immediately discernible practical applications.[2]

The research worker's reasoning should not be limited by mere physical data. Industrial research, in particular, requires the balancing of physical, economic, social, and psychological factors to an extent not always understood by those working in fundamental science alone. The more involved the problems become, the less the sole dependence on mathematical solutions, and the more the reliance on the imponderables of ethics, philosophy, economics, and human relations.

J. R. Van Pelt, Director of Battelle Institute, infers that many outside the laboratories may really possess more of the research instinct than some of those within.[3] In his discussion of the training of research engineers, he says: "In these remarks on the importance of scientific fundamentals, the scientific method, the skeptical attitude and the reasoning power, all the emphasis is on rigorous, logical thought. Logic is indeed good medicine for research, but an overdose of logic may be fatal. Brilliant research is the offspring of that happy pair, science, and imagination. Some of the greatest leaders in research, appraising the qualities that have contributed to success in research, have placed unquenchable optimism, freedom from restraint, and uninhibited imagination far above technical knowledge. It is along the frontiers of knowledge, not in the well traveled interior, that adventure is to be found. There the imagination can take wing; there the rewards of intellectual courage are greatest."

Again, Howard makes the statement:[4] "The longer a company has been carrying on an extensive research program, the richer that company is. This wealth does not appear on the balance sheet. It manifests itself each time a new demand is made on the company. It also appears as a social factor, because all the members of the group feel that they share a common wealth of knowledge. No matter how thoroughly and promptly the results of this scientific work have been published, there remains a somewhat intangible body of material which cannot be published, but which the group draws on constantly in its new production efforts. The small business that incorporates its own research department is adaptable, mobile, socially integrated, and profitable."

As Kettering remarked recently in Chicago: A modern version of the second law of thermodynamics is—"you can't hit a fellow going faster than you are."

Production Research

Research is under way in all branches of the petroleum industry—exploration, drilling, production, transportation, refining, petrochemistry, marketing, and end use. Production research in its broad sense as used in this paper will include both laboratory and field investigations concerning the geological processes of oil accumulation, exploration or the finding of oil, exploitation or the actual recovery of oil, and such supplemental subjects as pipe line transportation, and economics.

It has been estimated that the entire petroleum industry in this country is spending from 70 to 75 million dollars annually for research, and employing more than 10,000 people. About half of this number are professional technical personnel. An estimate has been made that 15 per cent of the total program for the industry is devoted to research in the production of oil, or that some 1500 people are engaged in this branch where about 11 million dollars is being spent annually in this endeavor.

The primary goals of production research, as elsewhere, are: cost reduction, protection of the public interest through conservation and through the development of new and better exploration tools, the development of synthetic liquid fuels, and methods for the economic mining of vast oil shale and other surface deposits.[5]

Some of these goals are competitive and are therefore approached singly in the laboratories of individual companies. Other goals are more distinctly cooperative in their nature and are subject to the joint efforts of groups of companies, or by trade associations, such as the American Petroleum Institute.[6]

Organized Production Research

The Pennsylvania Grade Crude Oil Association, representing a group of operators in Pennsylvania, maintains a laboratory at Bradford devoted primarily to research and development related to increasing oil recovery. Part of the work is done under contract by the School of Mineral Industries at The Pennsylvania State College and at the Armour Research Foundation in Chicago.

Drilling Research, Inc., formed as a cooperative enterprise by several producing oil companies, conducts research on new methods of drilling oil and gas wells.

The services available to established industry through individual support of research are not available to the smaller and newly organized companies. To supply these needed services the research institute type of laboratory has been developed during the last 25 years, to which anyone can bring technical problems and obtain

*Professor of Petroleum Engineering, University of Texas.

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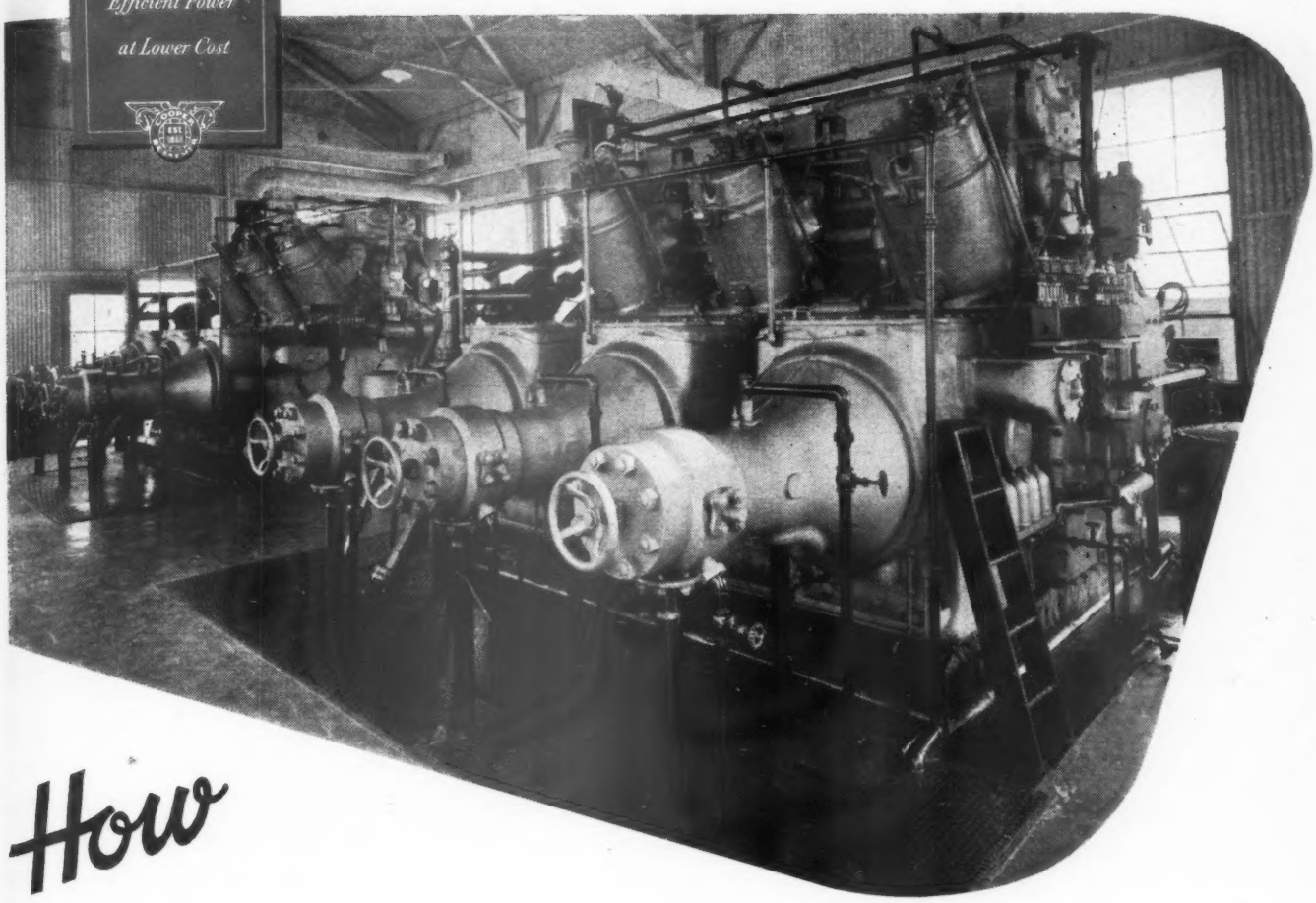

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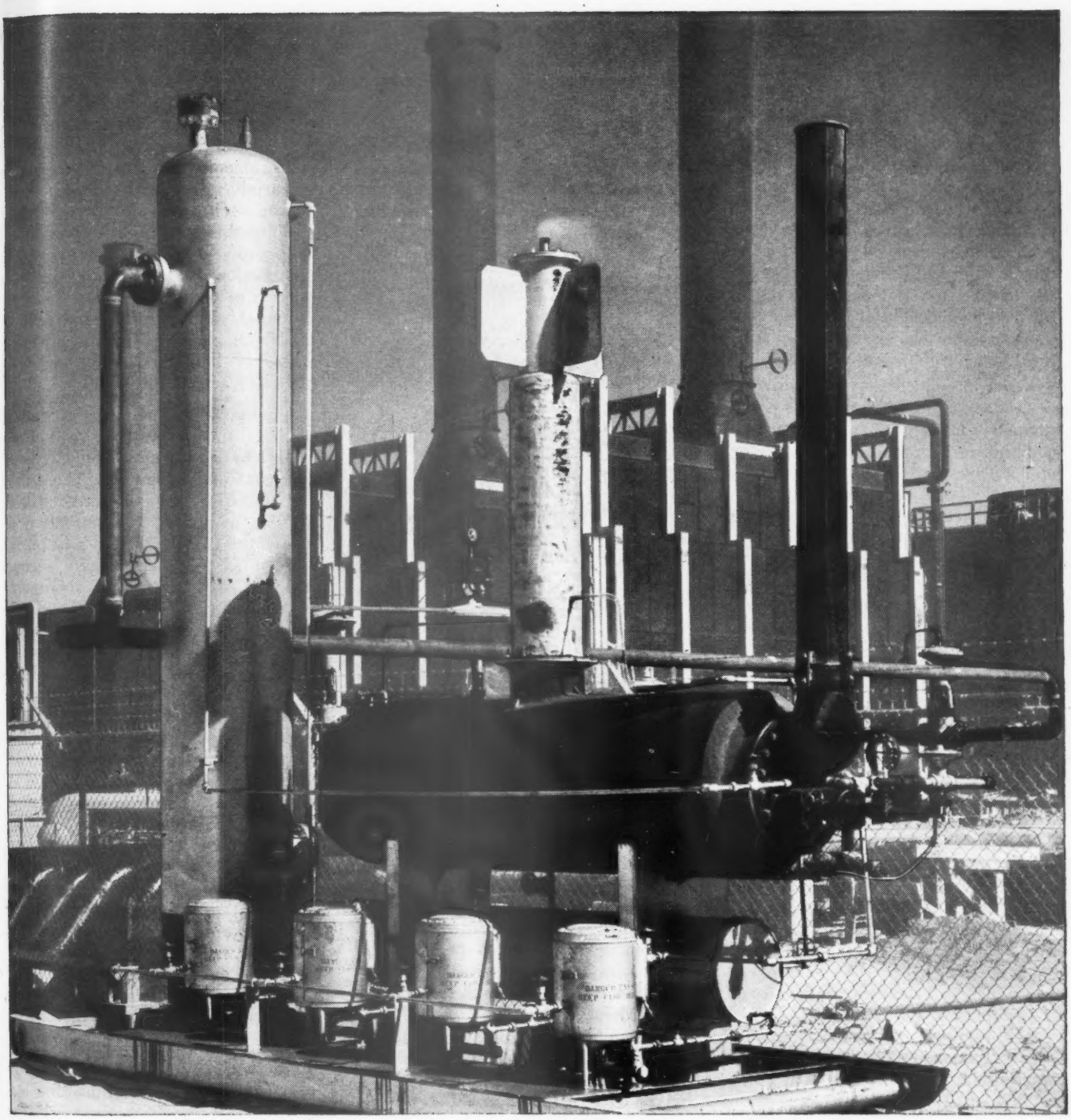

Glycol-type Dehydrator, Benedum Field, near Rankin, Texas. Texas National Gasoline Plant.

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help.[7] Several such institutes have been organized in Texas and other oil producing states during the past few years, including the Southwest Research Institute in San Antonio.

The Illinois non-profit corporation, "Institute of Gas Technology" affiliated with the Illinois Institute of Technology, Chicago, was formed to specialize in scientific instruction and research pertaining to the production, distribution and utilization of gas and its by-products.[8] Several research projects in the field of oil production are also under way at the Mellon Institute, Pittsburgh, Pennsylvania.[9]

Research at colleges and universities, as recognized generally, is a supplement to education. Education is a combination of teaching the known and reaching into the unknown. As a student's education is advanced, more time is given to research. Hence, the research program of an engineering school must be integrated primarily with education, if it is to fulfill the obligation implied in its support by the state.

As Professor Scott of Owens College, England, has said: "He who learns from one occupied in learning, drinks of a running stream. He who learns from one who has learned all he is to teach, drinks the green mantle of the stagnant pool."

Role of Academic Institutions

Specifically, with reference to oil production research, it is believed that the programs in academic institutions should stress the development of graduate students who, in turn, expect to engage in industrial research more directly aimed at increased recovery techniques and the reduction of costs of production.

It is highly important that the institutional research organizations function in a manner that will focus the best possible array of talent upon the projects under consideration. Within the university this may be done by utilizing the various talents in a cross-departmental manner. It is more than a one-department activity. The mathematician, the physicist, the chemist, the engineer, the economist, and others may be drawn upon as consultants, and the resulting research team thereby be permitted to work in complete harmony towards a common objective.

Likewise, close liaison should be established between academic institutions and other colleges, universities, industrial research institutions, research foundations, and the field, with a view to participation in a coordinated program of a breadth not otherwise found possible.

Representative Projects

The specific objectives in production research are many and various.[10] The projects under consideration throughout the industry are too many to enumerate, but it is in the province of this paper to name and describe representative ones that are prominent currently and hold promise for the future.

1. Program of the American Association of Petroleum Geologists.

The American Association of Petroleum Geologists is supporting a broad program of fundamental research in sedimentology.[11] This program is to be conducted as an integrated physical, chemical, and biological investigation of the processes and products of sedimentary deposition and post-depositional changes. It is to be directed at isolating and expressing the numerous relationships among these variables that are significant and important in oil discovery and production.

In the AAPG research program,[11] the objectives are the discovery of new methods and techniques that can be used: (1) In the recognition of petroleum accumulation provinces; (2) in scientific location of "stratigraphic trap" types of field; and (3) to increase the percentage of recoverable oil in fields that are found. Another objective is to reduce the cost of finding and producing oil, by improving present techniques and methods. Such an investigation will be conducted as a broad program, either by one agency, or as a group of specific projects in which the integration will be supplied by the research committee of the association.

Research in clay mineral[12] is aimed to increase the information concerning the properties and patterns of behavior and distribution of clay minerals in sediments that should be of assistance in the search for relationships to all types of well-logging; porosity, permeability, and saturation variations; also of assistance in understanding reservoir behavior, and as indices of depositional environment, and source beds of petroleum.

The organic sediments project[12] is aimed to investigate the occurrence and alteration of organic materials in sediments and relate these facts to other sedimentary variables. Correlation of data on formation waters with other significant geological occurrences in selected areas will constitute a separate investigation. The project devoted to bacteria will develop its principal functions in the deposition of carbonate, organic, and fine-grained sediments and the role of bacterial activity and bio-chemistry in post-depositional change.

The initial objective of the recent sediment project[12] is to investigate the processes and products of depositional environments, the areal distribution of variables in recent clastic and carbonate sediments, and the processes and products of post-depositional changes in the Upper Quaternary. The distribution of sedimentary variables in ancient sediments reflect both environment of deposition and post-depositional changes that must be separated if their vertical or horizontal extension is to be predicted.

The nature and manner of origin of porosity and permeability in carbonate rocks and consideration of the processes and products of deposition and post-depositional change will be studied, with particular attention directed toward the origin and development of "primary" and "secondary" porosity.[12] Techniques proposed include X-ray, thermal, chemical, and petrographic, as well as core analysis and plastic models. Supplementary investigations will include the solubility effects of weak acids, reduction of porosity by ground water, and movement of fluids through porous carbonate media. An increased knowledge of carbonate porosity should afford a basis for genetic classification, useful in the correlation of new carbonate producing areas with areas that have a long productive history. The prediction of new areas of porosity and the extension of old ones would be aided by the correlation of porosity with other geological features. The early evaluation of reserves and the most economical development of the new field should thereby be effected.

The processes of cementation,[12] active from the time of deposition and through the stage of diagenesis and lithification, and during post-lithification, must be related to the occurrence of petroleum and gas and hence are sufficient for extensive research.

Research in bore hole logging[12] is designed to determine the fundamental relations between such rock characteristics as porosity, permeability and lithology to electrical, neutron, gamma ray, X-ray and other reactions. Increased knowledge of control measurements will show in detail how these general relations may be applied in practice. Interpretation of individual logs will be improved by accounting for such mechanical factors as presence of the bore hole, thin layer effect, mud invasion, and type of mud.

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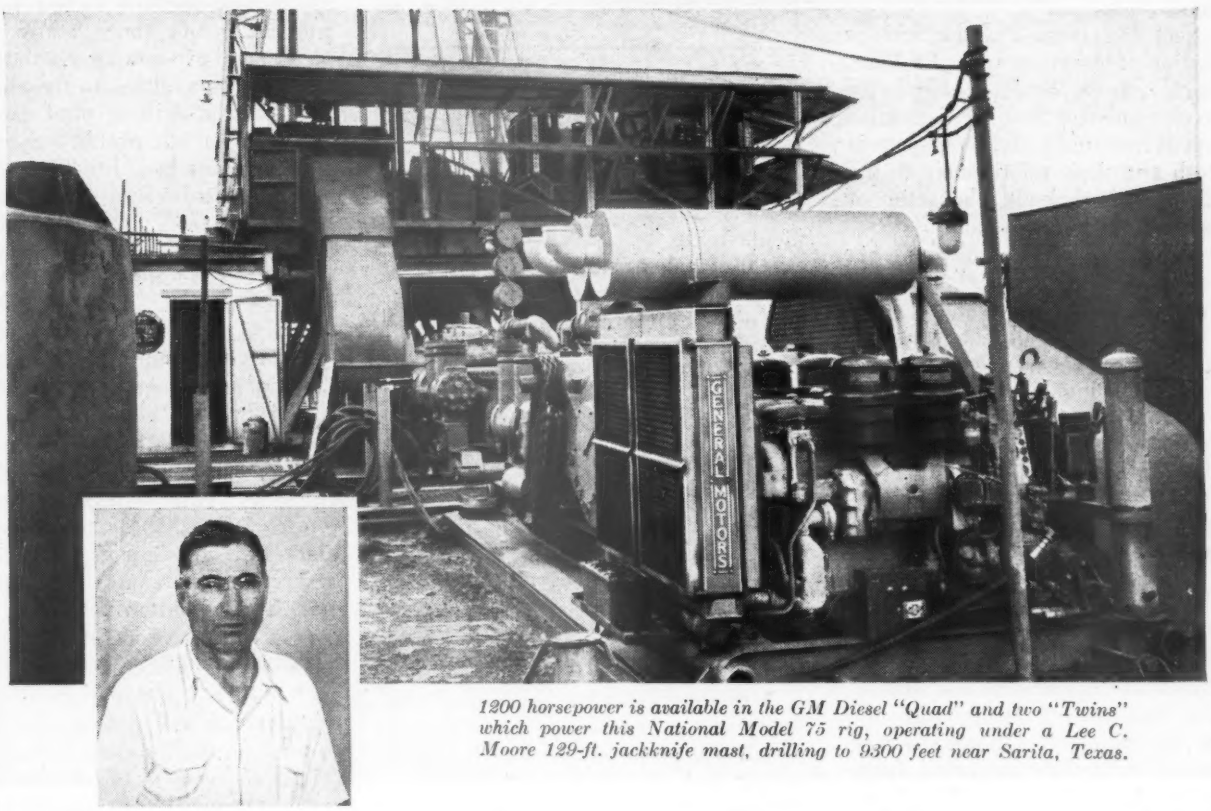
Allen & Morris Drilling Co.



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2. Projects of American Petroleum Institute in Fundamental Research.[5]

American Petroleum Institute Project 37, located at the California Institute of Technology, is concerned primarily with the determination of the volumetric and phase behavior of single and multi-component hydrocarbon systems.

Project 43a, located at the Scripps Institution of Oceanography, La Jolla, California, is devoted to a study of micro - organisms, first to determine the occurrence and activity of bacteria at depth and their relationship to the chemical and geologic character of the sediments, and second, to determine the utilization of molecular hydrogen by bacteria and its transfer in organic systems. The results to date indicate that certain sulphate reducing bacterial strains can transform organic material into paraffin hydrocarbons under laboratory conditions, and hence another mechanism is obtained for the original formation of oil in the sediments.

Project 43b, located at The Pennsylvania State College, is concerned with the problem of optical rotation found in all petroleum, and whether it can be used to characterize the material chemically.

Project 43c, located at the Massachusetts Institute of Technology, involves the radio-active bombardment of organic materials extracted from recent sediments in order to determine whether hydrocarbon material can be produced. Work is also under way to relate the existence and strength of natural radio-activity to depth and type of sediment.

3. U. S. Bureau of Mines Research Program.[13]

The U. S. Bureau of Mines research program is conducted in accordance with the provisions of the Synthetic Liquid Fuels Extension Act, particularly with respect to the recovery of liquid fuels from oil shale and agricultural residues; also involving the processing of high-sulphur crude oil.

4. Drilling and Development.

In drilling, attention is focused currently on deep well, hard rock, and offshore operations, with cost reduction the primary objective. A brand new method for drilling wells is now demanded with strongest pressure from the exploration division of the industry. In the final analysis, the principal way of discovering an oil bearing stratum is by means of the drill. Included in the many projects under way are: percussion or hammer-bit drilling, the successive use of controlled explosives, the use of mud-powered turbines directly connected to the drilling bit, the electro-drill, and jet-type drag bits.[14] Development work is being continued in an effort to make these devices practical, particularly in extending to 10,000 or 15,000 ft what can be successfully accomplished at the surface. Extended use of diamond-bit drilling with maximum core recovery is a notable current practice. Hydraulically driven and semi-automatic type rotary rigs, the result of intense mechanical research, are past the model stages and in full-scale operation. The methods of making hole in the past must give way to more efficient and less costly methods of the future.

Drillers Find Fish—Not Oil

A seismograph crew brought in a piscatorial gusher near Garrison, North Dakota. Hundreds of small fish were disgorged in a strong flow of water from the hole. About 1½ to 3 inches in length, the fish included catfish, pike, and river minnows. Officials state that the drillers may have hit an underground stream that connects with Crooked Lake fish refuge about seven miles away.

The accuracy of depth measurements should be investigated as insurance that thin productive sands will not be overlooked.

A new combination perforator and tester is now available by means of which the steps of perforating well casing and sampling the fluids in the exposed sands can be performed in a single operation. This eliminates one withdrawal of equipment from the hole and thereby speeds up drilling operations.

A comprehensive evaluation of drilling muds occupies an important position in most production research programs because of the growing realization that mud of improper constitution or incorrectly used mud results in trouble and increased drilling costs.[15] A never ending series of research problems is presented for drilling muds, especially with reference to deeper drilling at increased reservoir temperatures and pressures.[16] The force requirement necessary to overcome gel strength in these regions are necessarily related to chemical treatment. Simplified instruments for measuring gel strength are needed for field use. New chemicals including synthetic organic compounds must be found to reduce water loss. Oil emulsion stabilization constitutes a formidable research problem. New economical sources of starch material for drilling fluids will undoubtedly be found. Increased attention should be paid to a study of the various types of lost circulation, which may assume greater importance than the remedial materials themselves. Studies should be made of the effect of a combination of plugging materials on lost circulation. The losses occurring when circulation is regained are worthy of especial study.

Increased attention is required for so-called "tailor-made" muds to fill the requirements of a given pay zone. In drilling silt-stones, study of completion and production methods should be made in addition to the characteristics of the drilling mud used. It is possible that silt production and pore clogging may be a function of differential pressure across the sand fact, which may be a corollary problem to hydration with its consequent swelling and reduction of permeability. Further research may be postulated for mud fluids with respect to particle-size distribution, identification of the minerals, fractionation, systematic reblending, and chemical treatment.

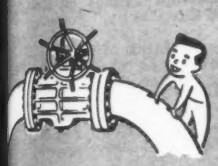
Researchers still feel a lack of fundamental knowledge concerning the character and behavior of certain types of clays.[15] All known commercial mud components, both natural and synthetic, also weighting materials and the oil constituents of oil-base muds are under investigation.

Deep drilling imposes greater responsibility for the proper selection of materials and design of drill pipe to prevent wear, washouts, and reduce frictional losses in the circulating system. As a specific example of results accomplished recently, drill string failures, that constitute a major problem in the Permian Basin, have been blamed variously on "war pipe," deeper drilling, mechanical damage, corrosion and other causes. The American Association of Oilwell Drilling Contractors requested Battelle Institute[17] to study these failures and find out how they could be stopped. Upon the Institute's recommendations, long strings of drill collars were used, sodium chromate was added to the mud, and drill pipe in some instances was coated with plastic materials. All of these and other recommended practices reduced the failures to such low proportions that the problem was no longer considered to be of importance.

Low water-loss cements show from 12 to 50 cu cm of waterloss as compared to more than 2300 cu cm for some of the usual cements.[18] The low water loss of these new cements should prove to be as important as the low water-loss muds in reducing water contamination of the formations while cementing casing and performing other well remedial measures.

Drilling through heaving shales not only presents problems in water, losses

So many features and every one IMPORTANT!

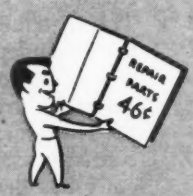


BY-PASS NECESSARY

with high differentials

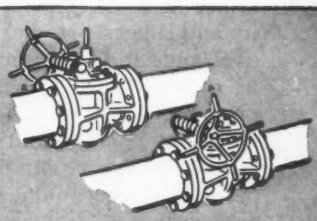
CORROSION AND EROSION EFFECTIVELY RESISTED

Lubricant pressure protects parts



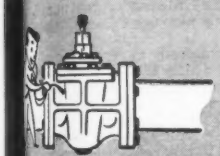
REPAIR PARTS AVERAGE ½ OF 1%

As compared with valve sales



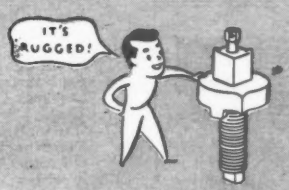
VALVE SETTING IN OPTIONAL DIRECTIONS

Not restricted to one-way flow



A TIGHT SHUT-OFF ALWAYS

pressure maintains seal



NO STEM BREAKAGE

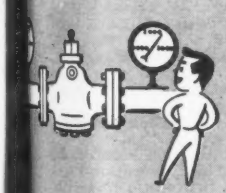
No excessive stress

FULL-FLOATING HYPRESEAL PLUG

Stem is independent of plug

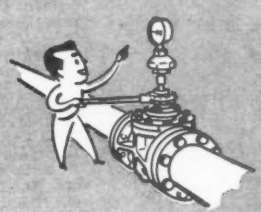
FASTEST CLOSURE IN FRACTION OF USUAL TIME

Can be closed slow or fast



CAN BE OPERATED AT ANY DIFFERENTIAL

...ging force to overcome



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from muds, but the minimizing of hydration pressures through the chemical treatment of the shales themselves.[19]

Other important problems in development operations include: Acid ahead of squeeze cementing[18] design of wire lines to meet the unusual wear and stresses of deep drilling, and the reduction of heat losses incident to steam rigs prompted by the greatly increased market price of gaseous fuel.

5. Core Analysis.

The sub-committee on Code 27 of the American Petroleum Institute continues its investigations of permeability and suggests studies of representative sands and synthetic porous media in order to determine the effect of pressure, pore size, and type of porous medium on permeability and upon the amount of error obtained by current permeability techniques, and the evaluation of the Klinkenberg extrapolation factor.[20] A proposal was made to determine the effect of ionic solutions on permeability and thereby ascertain the deviation of permeability obtained by such aqueous solutions from the permeability of the dry medium to gas.

Interest continues in relative permeability measurements. Undoubtedly past research undertaken will be extended eventually to simulate reservoir conditions of pressure and temperature.

The U. S. Bureau of Mines[18] is sponsoring permeability studies involving the flow of single phase liquids through porous membranes and the focusing of attention on the surface factors that affect permeability.

Work continues on the restored-state method for the determination of oil in place and interstitial water.[21] This method is of particular importance in unitization applications since the equitable distribution of hydrocarbons in place must be determined. The distribution varies directly with the complement of the interstitial-water saturation. The capillary-pressure measurement must be correlated with the location of the zone of 100 per cent water saturation in the sand. Difficulty has been experienced in obtaining the right capillary pressure for the specimen in the transition zone, or that zone between the 100 per cent water saturation and what is referred to as the irreducible minimum saturation. Fortunately, the transition zone in many reservoirs is not very wide, but in some cases unusually wide zones are subject to special studies, especially from the standpoint of interfacial tension. A promising extension of this work is a comparison with permeability, considered jointly with a correlation based on rock texture as determined by petrographic methods.

Capillary pressure curves may now be determined by forcing mercury under pressure into the evacuated porous media.[22] The procedure is said to be time saving and the range of capillary pressures which can be observed is 5 to 10 times that of past methods.

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To be concluded in an early issue.

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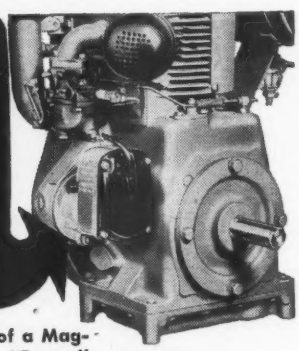

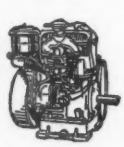

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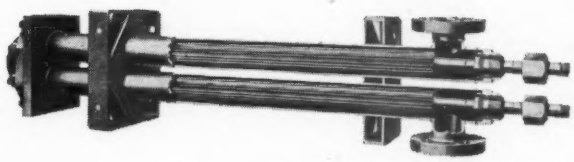

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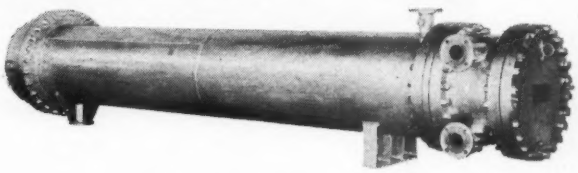

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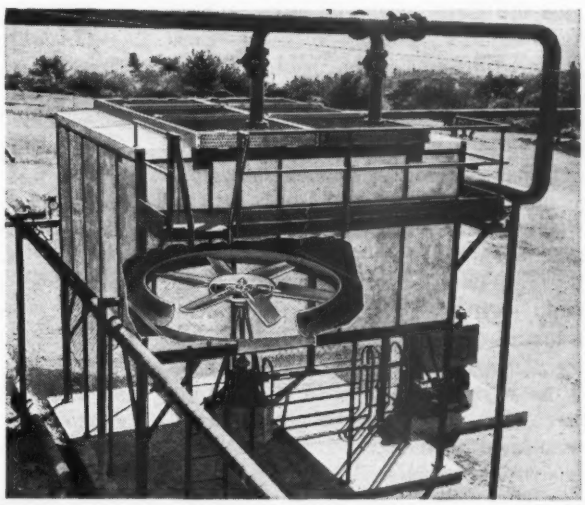

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PETROLEUM PROFILE

R. P. "Paul" Huggins

R. P. "PAUL" HUGGINS, the free-swinging southpaw veep of Western Gulf Oil Company, was born in McNary County, Tennessee, but before he had time to become rooted in the soil of his native state, he was whisked away by his parents to Gainesville, Texas. Here he attended high school and business college, concentrating on accounting, banking, and baseball, showing much more than the usual aptitude at all three. He had worked for Gulf Oil Corporation off and on while trying to get himself oriented following the completion of his schooling, but it was not until after the close of the first World War, in 1921 to be exact, that he was given a permanent assignment at Houston, Texas. There he demonstrated such a keen understanding of debits and credits that he was placed in charge of general accounts for the Gulf Production Company in that area. During this time his experience was enlarged by the execution of several important auditing jobs for his company in Mexico. In February, 1928, he was moved to Los Angeles as chief clerk of Pacific Eastern Production Company — now Western Gulf Oil Company — and from that time on he has never taken a backward step, excepting perhaps to dodge one of his own divots.

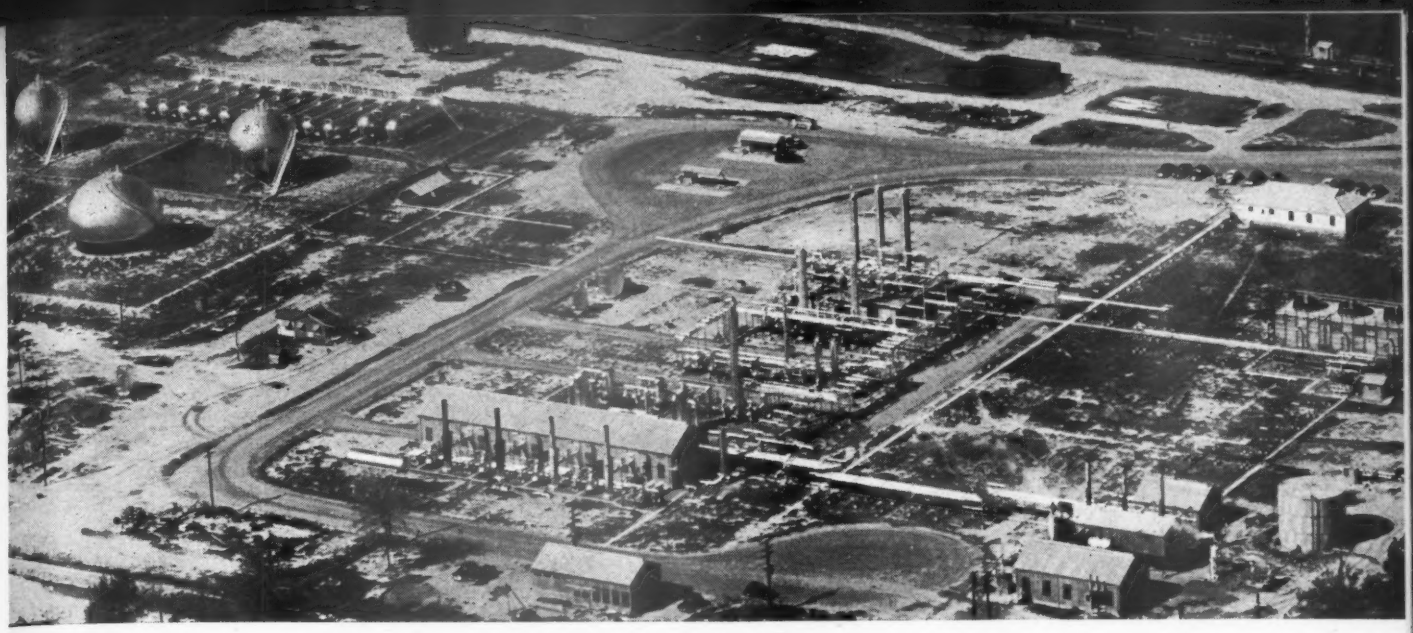
Through a long series of promotions he was eventually named general agent of the western concern, and thereafter, under his direction, the scope of the company expanded rapidly. It was responsible for the Oak Canyon and Paloma discoveries in 1939. Paloma proved to be a major oil field with a large condensate gas cap, and Paul Huggins worked ceaselessly toward its complete unitization in order to make cycling possible. His labors were well rewarded. Paloma became California's first unitized condensate field, and he has been chairman of Paloma Operators Committtee since it was originally organized in 1942. In recognition of his well demonstrated organizational and administrative abilities, he was made vice president of Western Gulf Oil Company in 1947.

It doesn't matter what Paul Huggins tackles, he does it with all his might. He is a past president of the Petroleum Accountants Society; past Big Shot of the Nineteeners, one of the industry's most exclusive golf groups; past president of the Oil Club of Los Angeles; past president and one of the founders of the Petroleum Club of Los Angeles; a director of the Western Oil and Gas Association, and he has held a number of important chairmanships in the varied activities of the Conservation Committee of California Oil Producers, of which he has long been a member. He is also a member of the Wilshire Country Club, and has a golf swing that is as uninhibited as Bob Hope.

When he smacks a golf ball square on its little perimiter, it takes a long, long journey down the fairway, but when he clouts it slightly off center, as he sometimes does, it sails in a wide, graceful, but exasperating arc, far into *verboten* territory. Before it has landed, however, another one is on its way — somewhere — for Paul Huggins is no dawdler. He played semi-pro baseball in his younger days, traveling all through Texas and Oklahoma with a North Texas nine, and later playing with a Galveston Club. As a left wing pitcher he garnered sufficient wins to attract the attention of professional scouts, but rejected all of their offers in favor of the petrolic adventure. He wound up his baseball career playing for Gulf in Houston between 1921 and 1927.

Indoors there is no game in the Hoyle lexicon that he doesn't play well. At dominoes he is a voracious counter, having familiarized himself with the multiples of five at an age when most children are screaming for duller safety pins. He has that keen card sense that enables him to get the most out of any kind of cribbage, bridge, or gin rummy, and like most southpaws he is completely lacking in what might be termed "investment fear." so he should be strictly avoided by the small timer.

Ordinarily, Paul is serious to the point of prepossession. but he flashes an easy smile, is friendly and responsive, and when the occasion is right can without any great effort limber up and become the life of the party. He is widely and popularly known in the California oil industry, and is highly regarded—both for what he has done, and for what he is. Incidentally, he has just returned from Harvard Graduate School of Business administration, where he added extensively to his business lore by attending the 16th Session of the Advanced Management Program.



Delhi plant of Sun Oil Company.

P 111.35

The Delhi Area Fields, Louisiana

F. G. PRUTZMAN*

THE Delhi-West Delhi field of northeast Lousiana, and its several companion fields, South Delhi, Big Creek, and South Big Creek, has progressed from the discovery well of December, 1944 to a full-fledged field of major importance. Development is virtually complete and production operations are at a routine, settled pace. At the time of this writing the fields, four of which are recognized as separate entities, have produced about 35,000,000 bbl of oil. The Holt-Bryant Zone, principal reservoir in the area in which the discovery was made, has produced about 25,000,000 bbl. The Delhi-West Delhi field has 254 wells producing from the Holt-Bryant Zone and several isolated sands and stringers; the South Delhi field, 13 producing wells; The Big Creek field, 96 wells producing from a number of lenticular sands; and the South Big Creek field, 7 producing wells.

The term "area" is used rather generally in reference to the above fields due to their close proximity to one another and due to their simultaneous development. The area in general comprises a belt of production about 17 miles long and 2½ to 3 miles wide with the long axis in a northeast-southwest trend. The fields are situated within Richland, Madison, and Franklin Parishes lying, geographically, between Monroe, Louisiana and Vicksburg, Mississippi. The topography is characteristic of the Louisiana Bayou country, with surface elevations ranging between 60 and 100 ft, and averaging about 90 feet.

*Petroleum Engineer, Sun Oil Company, Dallas, Texas.

Discovery Data

The discovery well was drilled as a joint venture of C. H. Murphy, Jr. of El Dorado, Arkansas and Sun Oil Company. It was the end result of a belief in the existence of a stratigraphic trap along the south flank of a broad structure known as the Monroe Uplift, or Sharkey Platform, brought about through the truncation of Cretaceous sands by later formations. This belief, founded upon detailed surface and subsurface geology, was confirmed by seismic work, and the discovery well was located on a structural feature indicated by seismic means.†

Development progressed rapidly but orderly on a regular 40-acre pattern with drilling initially spreading gradually outward from the discovery well. Development was accelerated later on following the successful completion of several wells at stepped-out locations some 4 to 5 miles distant, principally to the southwest. The first of these was R. J. Caraway's L. Bryant No. 1, 4½ miles southwest of Murphy-Sun's J. E. Holt No. 1, establishing the West Delhi field. This field was subsequently found to be in communication with the Delhi field. The Paluxy "B" sand of West Delhi was found to be the same as the Basal Tuscaloosa (locally known as "Barrier") sand of the Delhi field, constituting a common reservoir.

As many as 25 rigs operated continuously during the development stage. Most of them were gasoline engine-powered portable rigs. Drilling was comparatively simple, the principal difficulty resulting from the necessity for building board roads into most locations through low swampy land. Wells were completed generally with 9⅝-in. or 10¾-in. surface casing set about 500 ft deep and cemented to the surface. The oil string was usually 5½-in. or 7-in. H-40 casing. It was generally set through and gun perforated. Drilling time was comparatively short, averaging about 25 days from "rig up" to "tear down." Wire line coring was done extensively at first but this practice was reduced or eliminated on most the in-fill locations.

Drilling Problems

There were no particular drilling difficulties. Mud weighting materials and chemicals were necessary principally to control viscosity and to keep

†Detailed reports of the early development and geology of the field have been given in previous papers, Ref:—A. S. Rhea—*Petroleum Engineer*, Nov., 1945; A. M. Lloyd—AAPG, 1946.

EXCLUSIVE

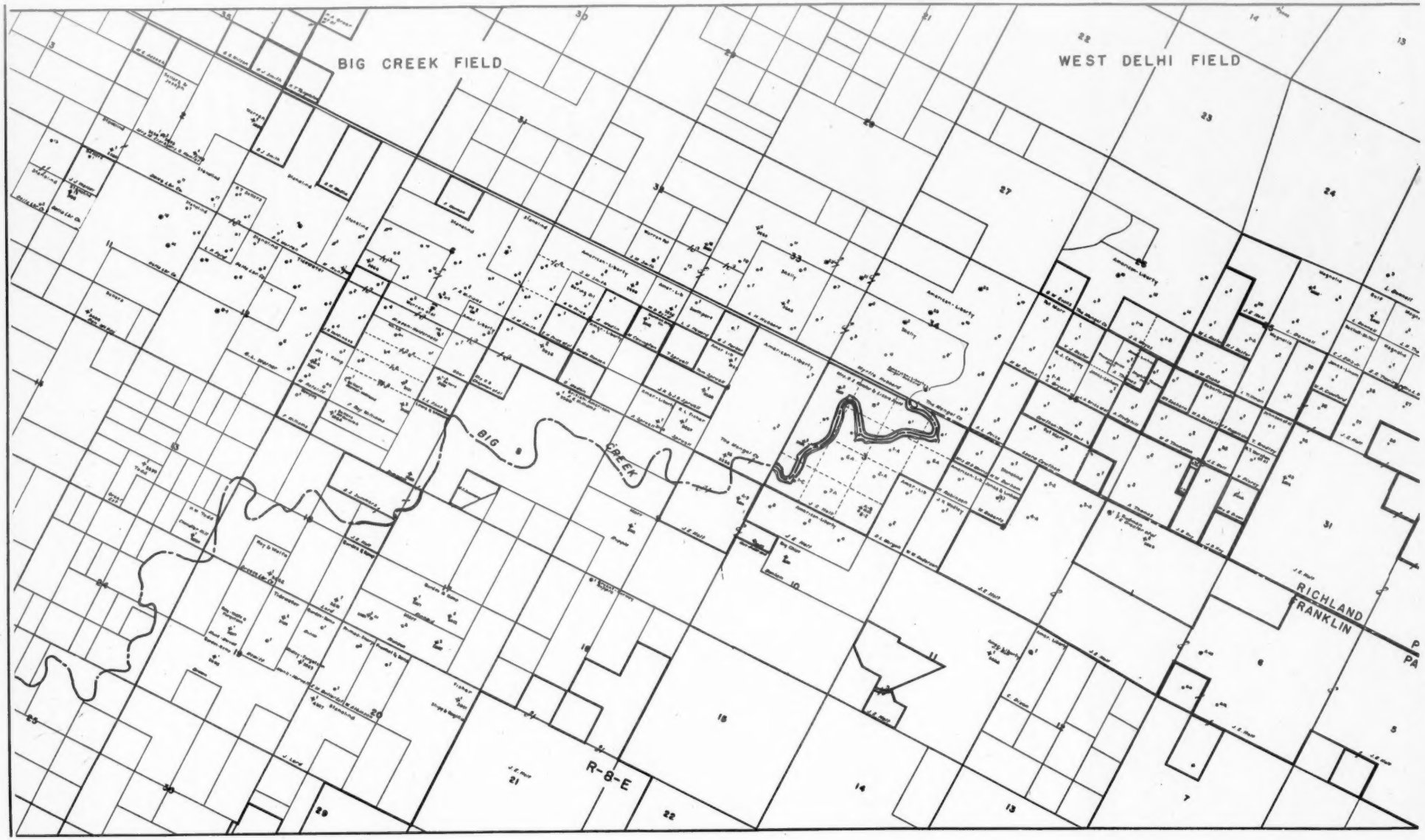


FIG. 1. Westerly portion of the Delhi area fields. The cross-section (Page B-10) indicates the subsurface break between the Delhi-West Delhi reservoirs and the separate reservoir of the Big Creek field, which is not clearly apparent from the development map above. The South Big Creek field produces from deeper lenticular sands.

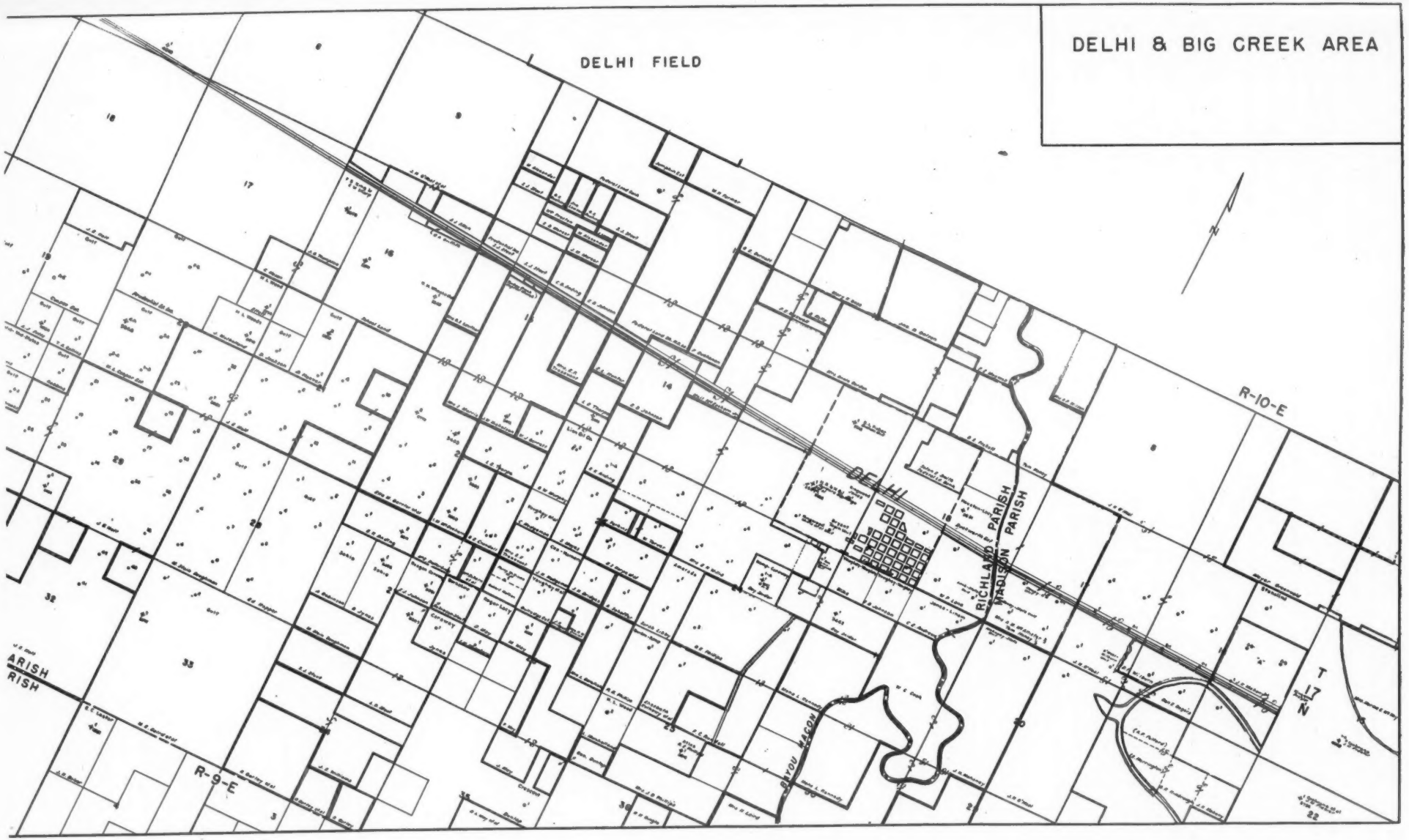


FIG. 2. Easterly portion of the Delhi area fields. The West Delhi field joins the Delhi field at the left side of this map and both produce crude oil from the same reservoirs, the Holt-Bryant Zone and the May Sand, at depths of 3060 to 3520 ft. Note that wells are spaced uniformly on 40-acre drilling units.

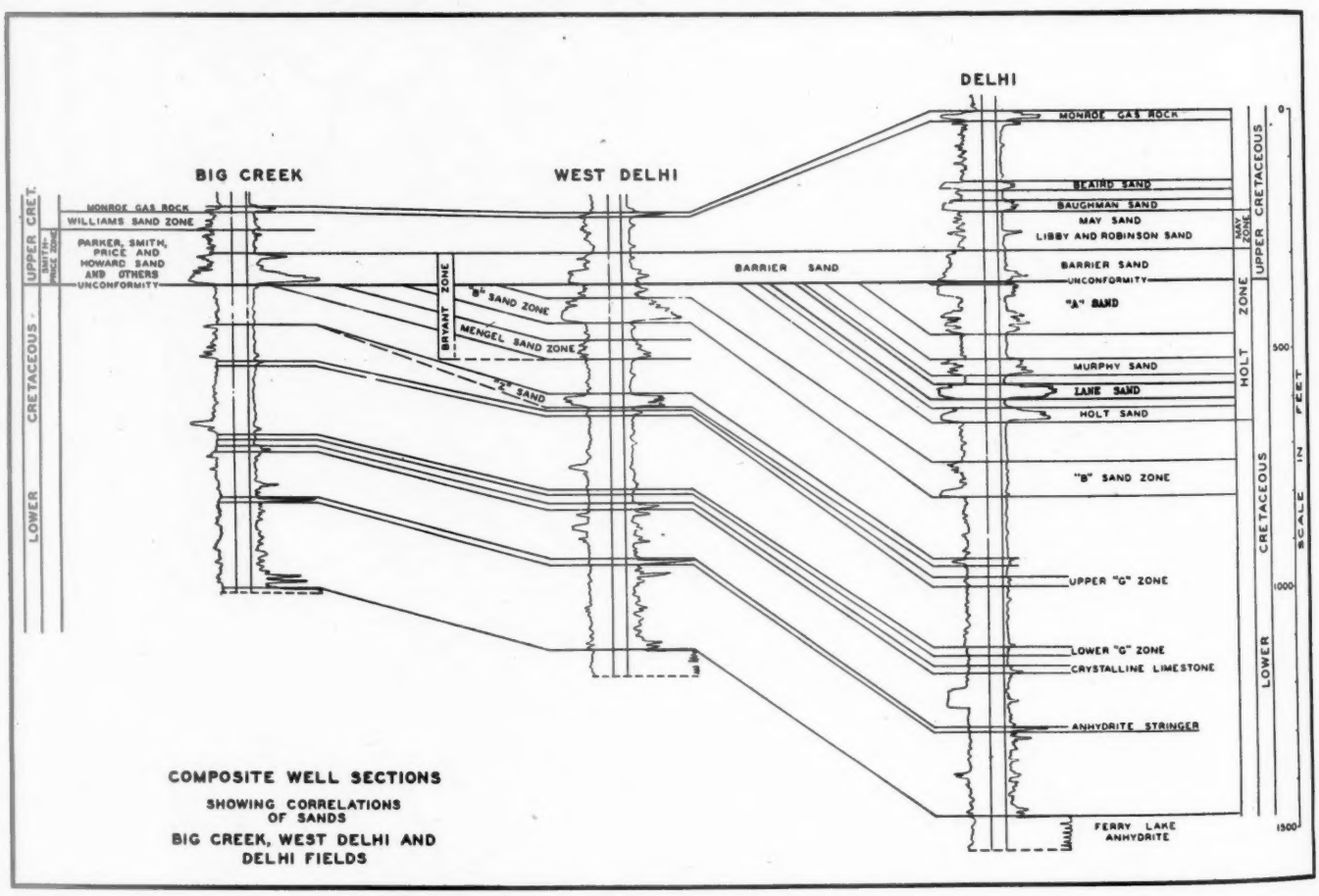
the weight up to about 11 lb per gal while drilling in, which was sufficient to overcome the formation pressure. The Wilcox section, between 1500 and 3000 ft, contains salt water bearing sands and necessitated some mud control to prevent salt water flows. This was not a serious problem, however. The cost of drilling and equipping the 3500-ft wells ranged from $20,000 to $25,000. The cost of building roads was considerable. A second complete board road often had to be built over the first one after the combination of mud, rain, and heavy traffic had completely submerged the original road in a mire of mud. Upon completion of a well, or wells, and weather permitting, permanent roads were constructed with a graveled surface. These roads were built to an elevation above recorded highest flood waters. A field-wide system of permanent graveled roads has now been completed, permitting easy access to any part of the productive area.

During the development of the main Delhi-West Delhi reservoir, several smaller, separate reservoirs were found. The principal one was the May Sand reservoir, which was found along the southeast edge of the main zone about one mile south of the town of Delhi. These small reservoirs are principally stray Tuscaloosa sands above the Barrier, and, due to the steep dip of the lower beds, they are found at generally greater depths than the Barrier. Most of these stray sands are of minor importance with the drive mechanism being principally dissolved gas. The main reservoir, the Holt-Bryant Zone, however, is operating under a water drive.

Big Creek Field

The Big Creek field, immediately to the west of the Delhi-West Delhi field, and from the surface appearing as an unbroken continuation, was discovered in July, 1945 by the successful completion of American Liberty's L. S. Howard No. 1, situated in the NW/4 of the NW/4, Section 4-16N-

FIG. 3. A West-East cross-section from the Big Creek field to the Delhi field shows the lenticular nature of the producing sands in the Delhi area fields. A key map (below) indicates the extent of the cross-section.



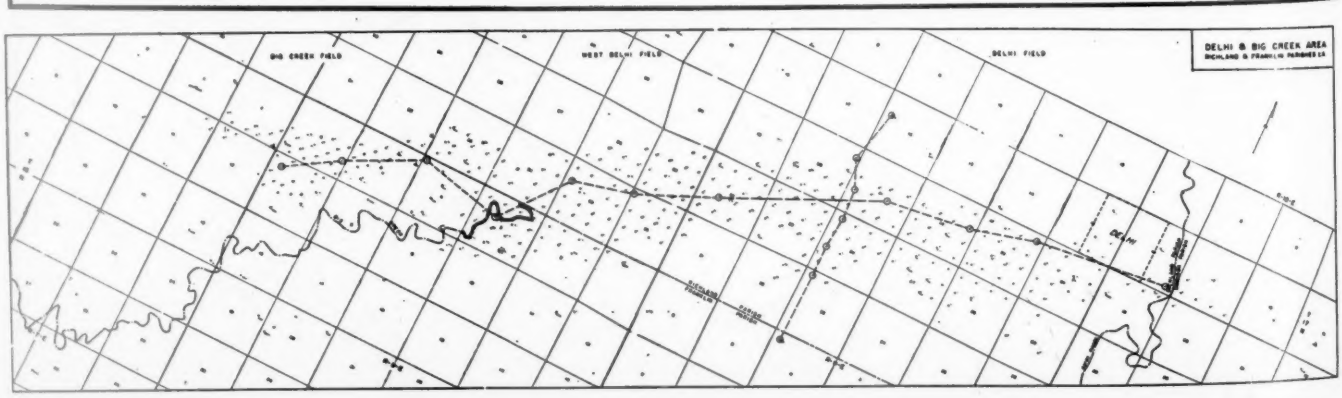
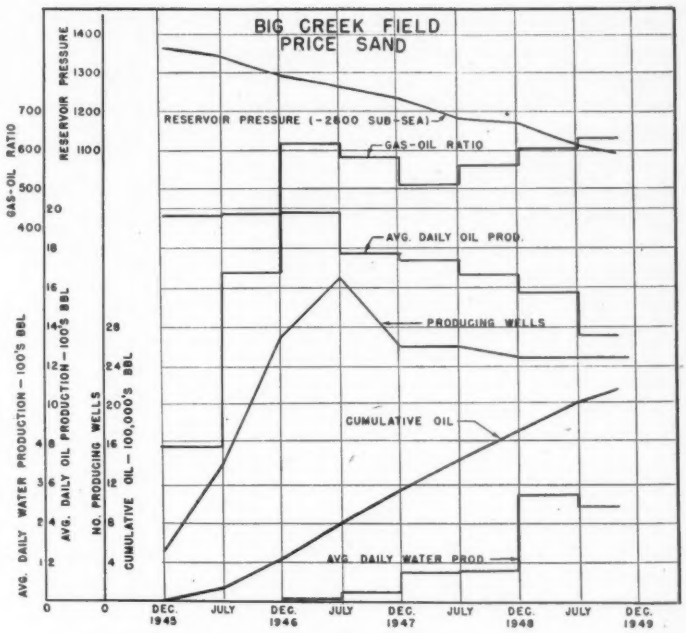


TABLE 1. Reservoir data for fields in the Delhi area of Louisiana.

	Delhi-West Delhi		Big Creek	South Delhi
	Holt-Bryant Zone	May Sand	Price Sand	Kny Sand
Producing depths, ft	3060-3370	3280-3520	2800-3000	3550-3650
Avg. effective section, ft	30	6	20	15
Porosity, per cent	33	32	32	30
Permeability, md.	0-5000	0-5000	0-4000	0-5000
Connate water, per cent	35	35	45	40
Gas-oil contact, ft (subsea)	3135	None	None	3519
Oil-water contact, ft (subsea)	3286	None	2901	3569
Avg. gas-oil ratio, cu ft per bbl (original)	440	380	380	400
Original reservoir pressure, psi	1530	1556	1365	1669
Oil gravity, deg. API	41	39	41	43



8E, Franklin Parish. This, the first of a number of lenticular sands, is typical of most sands in the field, being of small areal extent, thin section, and primarily of dissolved gas drive. Subsequently, the Bering Oil Company completed it's R. W. Price No. 1, one-half mile to the southwest of the discovery well, in the so-called Price Sand. This sand has proved to be the most prolific in the field and the only one that has exhibited a substantial water drive.

Production in the Big Creek field is from the Marine Tuscaloosa, which rests directly upon the Upper Glen Rose, the Basal Tuscaloosa being absent. The Upper Glen Rose members in the Big Creek field have not yielded oil in commercial quantities. There are several Glen Rose producing wells, however, in the Delhi-West Delhi field. Producing depths in the Big Creek field range between 2850 and 2950 ft. Drilling conditions are comparable to those in Delhi-West Delhi, the wells being completed for slightly less cost due to the lesser depth. Development was carried out initially on a 40-acre spacing pattern, however, due to the lenticularity of the sands, the Louisiana Conservation Department permitted 20-acre spacing in July, 1946. Development progressed simultaneously with that of the Delhi-West Delhi field.

In January, 1946, Primos and Sharp, of Monroe, Louisiana, completed their Butler No. 1 in a stray Tuscaloosa sand about 2½ miles south of the Big Creek field. When subsequent development proved that neither the Big Creek nor the Delhi-West Delhi fields extended in that direction, this area was designated the South Big Creek field. Lenticular conditions prevail as in Big Creek. Producing depths are about 400 ft greater due to the southward dip of the beds. Development of this field progressed rather slowly due mainly to the fact that the discovery well was a poor one, going on the pump upon completion. Eventually, however, in the following two years seven more producers were completed. Oil production from this field now totals about 600,000 bbl.

A fourth separate field, known as South Delhi and lying about 1½ miles south of the main Delhi-West Delhi field, was discovered in March, 1945 by completion of American Liberty's J. B. Kny No. 1, in Section 12-16N-8E, Franklin Parish. This well was completed in the gas cap of what later proved to be an 11-well reservoir. Total oil production to date is about 580,000 bbl. Subsequent to the discovery well, several productive sands were found and this field, including all sands, now contains 13 producing wells, with three having been abandoned to date. Total oil production for the entire field amounts to about 645,000 bbl.

A number of small gas reservoirs have been found both north and south of the Delhi-West Delhi field. The reserves are of a relatively minor nature, however, and hardly sufficient to warrant the establishment of a sale outlet. Most of these wells have remained closed in or have been utilized in field gas lift installations. Surface pressures range from 1400 to 1500 psi, and the gas is very lean.

Characteristics of the various sands and reservoirs in the Delhi area are similar in many respects, particularly sand conditions. Fluid characteristics differ considerably, however. A comparison of some of the major characteristics in idicated in Table 1 above.

A detailed performance history of all wells and reservoirs has been compiled systematically by the Delhi Area Engineering Committee, whose committee members represent a majority of the Delhi area operators. This committee was organized in 1946 in a cooperative effort to collect and compile factual data for evalution by the various operators. Field-wide pressure surveys have been run quarterly, and production and pressure data have been compiled in such a manner as to permit close surveillance over the performance of the various reservoirs, permitting the establishment and maintenance of efficient producing rates. Thus, with complete and reliable data available to all, an exceptional degree of cooperation has resulted. This was exemplified in recent months by a voluntary request to the Conservation department for a reduction of the daily allowable for the Holt-Bryant Zone, from 109 to 89 bbl per well per day, when it became apparent that maximum effect from the water drive was not being obtained.

Gasoline Plant Constructed

A further example of the cooperation among operators in this area in the matter of good operating practices and conservation of resources was the construction of a casinghead gasoline plant, completed in May, 1948. This plant, operated by Sun Oil Company's natural gasoline department, is owned by a majority of the operators, each sharing in the investment and returns in the proportion of his acre-feet of oil sand to the total acre-feet represented in the plant membership. The plant is situated about 2½ miles west of the town of Delhi on U. S. High-

way 80. Radiating from the plant are some 65 miles of gas gathering lines ranging in size from 2-in. to 26-in., and some 25 miles of 2, 3, and 4 in. residue lines.

The Delhi plant is a low pressure casinghead gasoline plant with an inlet capacity of 17 million cu ft of gas per day, designed for extraction of propane, butane, and natural gasoline. The plant is now operating near capacity, extracting about 72,000 gal of liquid products daily. Residue gas, above that used in plant operation and returned to lease use, is sold to United Gas Company, whose transmission line parallels Highway 80. Gas is delivered at 540 psi.

Some 24,000 bbl of oil are moved daily from the Delhi area fields by pipe line. Sun Pipe Line Company moves about 85 per cent of this total through two 6-in. lines to Buckhorn Station on the Mississippi River, where the oil is loaded aboard barges for movement up or down river. The remainder of the oil is moved south by Interstate Pipe Line Company through a 7 and 8-in. line for delivery to the Standard Oil refinery at Baton Rouge.

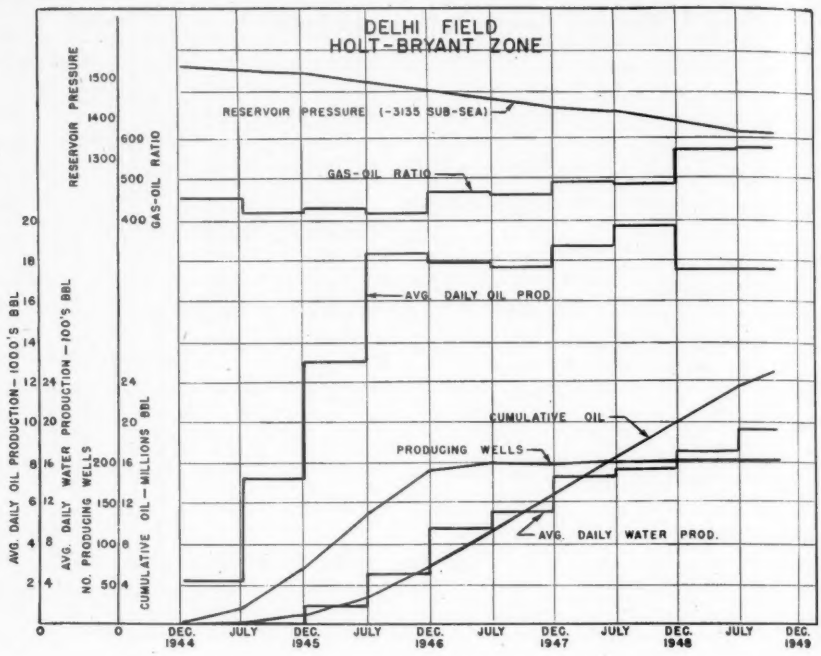
Producing Practices

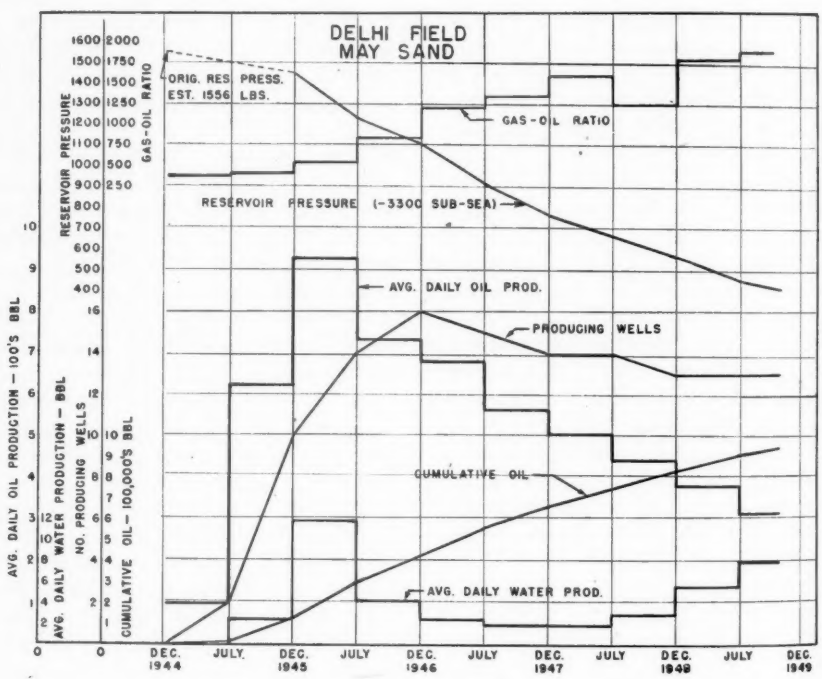
Operating problems in the Delhi area have not been especially severe, the most troublesome being the heavy accumulation of paraffin in well tubing, flow lines, and tanks, and, in several wells. The production of a fine, unconsolidated sand aggravates the problem of artificial lift.

Paraffin accumulates in the tubing from the surface to a depth of about 2000 ft. The most common means of removal has been the regular use of mechanical wireline scrapers. Flowing wells require such scraping about every 20 days. Those wells completed high above the water level are sometimes produced at fairly high rates, 300 to 400 bbl per day, in order to retard paraffin accumulation. This practice is restricted, however, due to the possibilities of channeling or coning water. As a general rule, the better flowing wells produce through a 12/64-in. positive choke at rates of 8 to 10 bbl per hr with flowing surface pressures in the neighborhood of 500 psi.

Flowline plugs, open fires, and steam have been used to keep flow lines clean during the winter. Flow line accumulation is negligible during the summer. High paraffin accumulations in tanks have necessitated the frequent use of circulating pumps, generally portable, with a source of heat sufficient to raise the temperature of the bottoms to about 130 F.

A number of wells have been worked over. The majority of such jobs were attempts to shut off water. As a general rule, where there is a comparatively thick section or where shale barriers exist, the workovers have been successful. Most of this work is done with portable units utilizing single or double pole masts.





Salt Water Disposal

A steady increase in salt water production has pointed up the need for subsurface disposal, and this need has been recognized. At this time, two systems are being installed, one by Murphy-Sun in the east end of the Delhi-West Delhi field, and one by Gulf Refining Company near the center of this field. Each involves the use of cement-asbestos gathering lines, closed systems employing sand filters, and injection wells drilled down dip into the Paluxy Sand of the Holt-Bryant Zone, the return of salt water thus supplementing the reservoir energy. It is planned that several additional wells will be drilled eventually to effect maximum use of the returned water.

The May sand, which is approaching the primary depletion stage, is being evaluated for secondary recovery measures involving water flood. It is anticipated that an active program may be begun within the next year.

* * *

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Well Treating Chemicals

A. L. FRYE

As every oil man knows, production decline is frequently more rapid than expected. Ever since Colonel Drake produced the first well, oil operators have spent much time, effort, and money in trying to lessen or halt this decline. Better rates of production from new offset wells prove that the oil is there, but the problem of holding this production remains.

Much laboratory study and research has been carried out in increasing amounts to supply the data for maintaining production. By the procedure outlined here, the comparative effectiveness of well treating fluids for washing and cleaning well samples may be determined. Field results from several hundred such determinations have indicated its value.

Selecting Samples

Every effort is made to obtain samples representative of the producing formations, that is, of the intervals to be treated. It is recognized that they may not always represent the formations potentially most productive. Through careful selection of bailings, cores, and sidewall samples, however, close agreement has been obtained between laboratory predictions, and results of later treatments in the well.

Substantial increases in production have resulted through the use of treating solutions tested by this procedure. Results in washing and cleaning well samples may be correlated with actual field results. Furthermore, where the cleaning is particularly effective—as demonstrated by these tests—the wells often maintain these substantial increases in production for a considerable time.

Declining Production

Loss of production, as numerous investigators have pointed out, is caused by many factors. Some of these factors are beyond control, but many can be changed or improved. One of the latter, plugging of the producing channels, is recognized as an important factor in causing production decline. This plugging or restricting of the oil flow occurs all the way from the virgin formation to the inside of the liner as the oil flows through the following regions:

The Author

A. L. Frye received a BS degree in chemical engineering from the University of Colorado. He was employed by the Richfield Oil Company in 1938 as a chemist in the exploitation department. In 1943 he joined International Cementers, Inc., as manager of the chemical department, where he was responsible for the chemicals, and for the design, supervision, and recording of all chemical treatments in California.

Muroc Clay Company employed Frye in 1944 to develop the use of its industrial minerals in the petroleum industry; however, the war interferred and in 1948 he opened his own office as a consulting chemical engineer. His office houses a laboratory, with part-time assistants to do testing and research work for oilfield clients.

1. The virgin formation.
2. Formations penetrated by foreign fluids, such as drilling fluids and edge waters.
3. Formations penetrated or plugged by solids such as infiltered mud, precipitated scales, and accumulated bitumens.
4. Walls of well bore and adjacent critical producing zone. Here, through filtering or mechanical plastering, highly impervious cakes of drilling fluid solids may be deposited.
5. Annulus between liner and wall of well bore. Here, as the perforations are bridged gradually by the larger solids, accumulations may build up behind them tending to fill the annulus.
6. The liner whether conventional, prepack, or gravel-packed.
7. The space inside the liner.

Mud, water, and bitumens may flow into the well bore along with the oil. Except as restrained by the mechanical equipment of the well and operating conditions, they tend to carry with them formation solids such as sand and shale. These solids settle inside the liner, or are trapped in the annulus between the liner and walls and in the critical producing zone. Bailing, perforation cleaning, and sidewall sampling may bring them to the surface for laboratory examination and study.

Laboratory Procedure

For the removal of these restricting materials, acids, strong alkalis, organic solvents, and various salts, such as phosphates and common salt may be used. In a particular well, however, which one will clean it most effectively and economically?

Years of field experience and study have led to the development of a procedure for answering this question. The effectiveness of the various well treating fluids used in the washing and removal of such plugging materials may be predicted. Equal amounts of the sample are placed in tared screen containers, specially designed to correspond to the annular section of the well. The sample, suspended from the top, then reacts about as it would in the well.

Testing Well Samples

Screen covered samples, as required, are suspended simultaneously in the various treating chemicals. Then the treating fluids are circulated through the screens and across the face of the samples. In a standard procedure, circulation is regulated to be just strong enough to remove disintegrated and dissolved materials, but not strong enough to remove hydraulically any of the unreacted material.

This rate of washing is determined from experience and from the simultaneous action of a standard or inert fluid on a control sample. By using low but positive washing speeds, the difference in the reacting rates of the various treating chemicals are more pronounced.

On well samples difficult to disintegrate in treating chemicals now available, however, the rate of washing is increased until disintegration of the plugging materials occurs. These data have been used to determine the type of hydraulic washer to use and the amount of washing necessary to clean out the plugging materials. In many instances, it has shown that additional treatments were necessary to obtain maximum results. Greater and longer-lived increases in production have been obtained through application of such data.

Periodically the screens are lifted out of the treating solutions, the samples drained, and then weighed. From this close control, additional informa-

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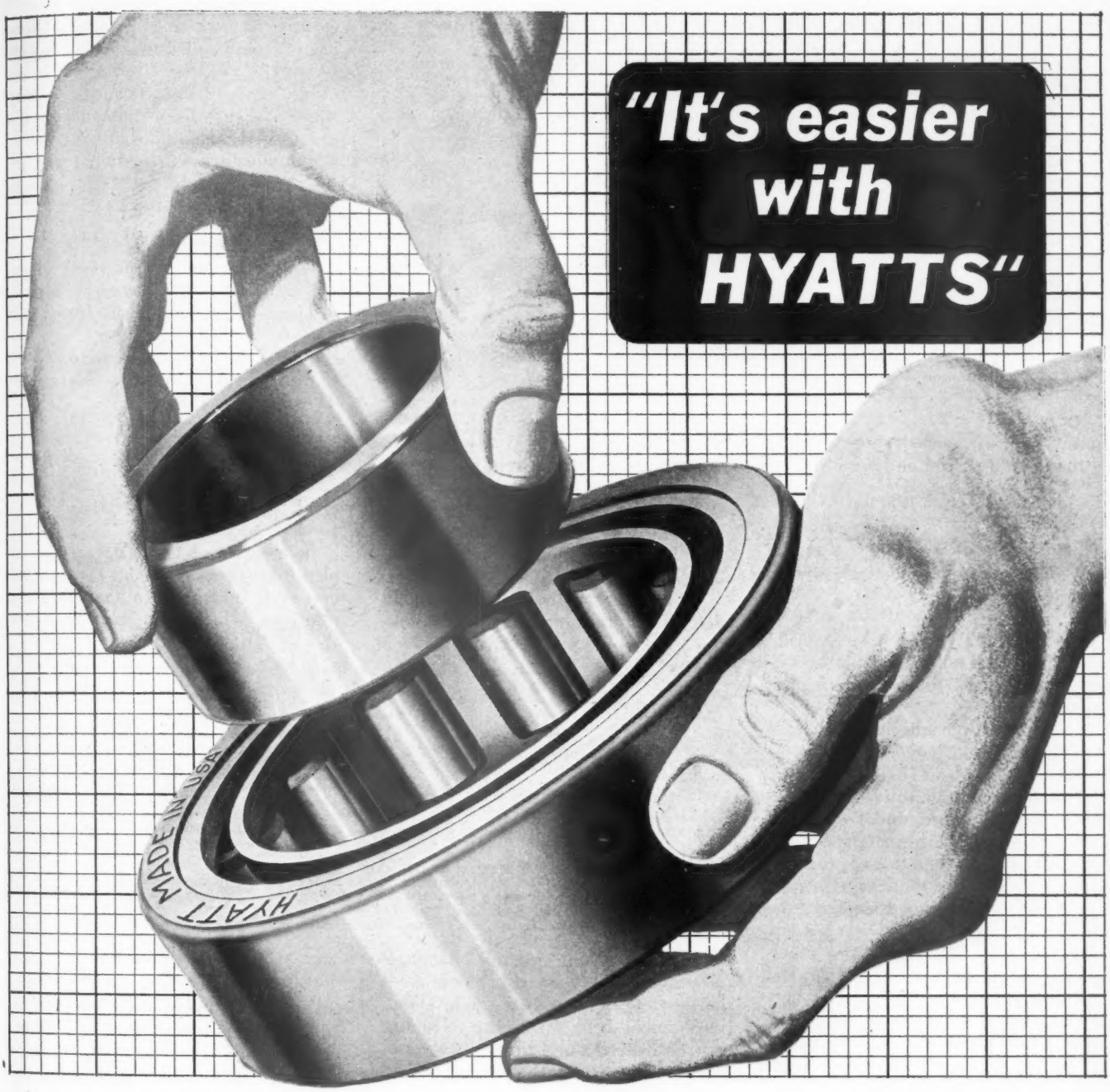

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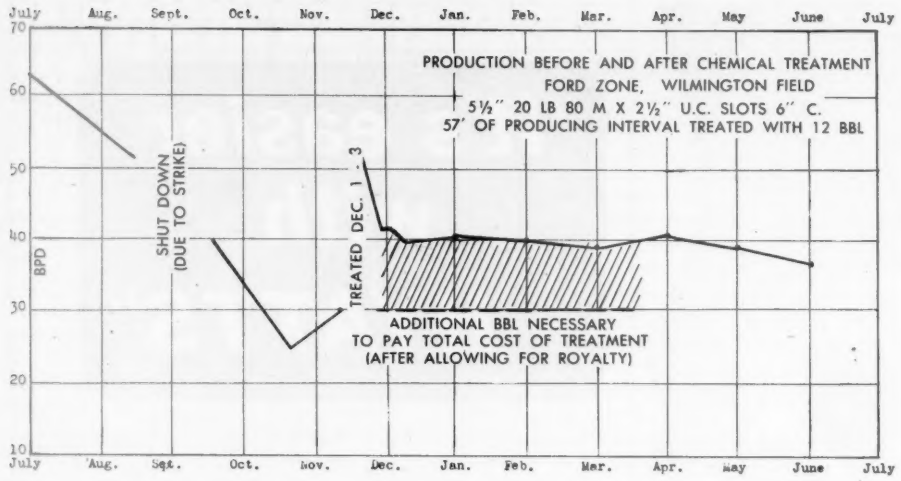


tion is obtained on the rate and nature of the disintegration and washing.

Sample Analysis

Meanwhile, a volumetric analysis is run simultaneously on another part of the sample. A typical analysis shows:

a. Oil.

b. Emulsion.

c. Free water.

d. Sand and silt. Solids plus 200 mesh and minus the size of the test screen.

e. Mud and fine silt, i.e., minus 200 mesh solids.

f. Coarse solids as shale and gravel.

As only the coarse solids will be retained by the screen under complete washing and disintegrating conditions, the sum of the others is the limiting amount of the material that may rise, settle, dissolve, or drain from the test sample.

Bottom hole temperature is maintained while each treating chemical reacts and cleans.

The tests are concluded when the consecutive weighings show little or no increase in removal of test material, that is, when all the fines have been washed out. This corresponds in the well to obtaining a natural gravel pack; to the determination of the maximum permeability or cleanout obtainable with a particular treating chemical.

Remarks

1. Procedure and equipment are available for determining the comparative effectiveness of treating solutions and chemicals in removing materials that tend to restrict production.

2. This procedure has been outlined in general terms, because of:

a. The number of modifications possible.

b. The amount and accuracy of the data available about the sample governs the amount and accuracy of research warranted in determining its comparative disintegration in the treating solutions. The more that is known about its history in relation to the conditions of the well, the greater the value of the data.

3. Within the limits imposed by the uniformity of the aliquot parts of the sample and the accuracy and control desired, these results are reproducible.

4. This procedure and equipment determines the maximum comparative effect of washing solutions such as salt water and treating chemicals now available to oil operators. With bottomhole temperature maintained, mechanical and hydraulic cleaning can be held at a minimum. Combinations of chemical with mechanical and hydraulic methods of cleaning have increased production, but evaluation of their comparative effectiveness requires further data.

5. The effect of pressure on the comparative effectiveness of these solutions can be determined by using more elaborate, pressurized equipment. Previous investigators have found, however, that where there is no appreciable change in volumes during the cleaning, the effect of varying the pressure is minor.

Through use of this procedure and equipment, treating solutions have been recommended that have been effective in cleaning the liner, the annulus, and the critical producing zone. This has been indicated by the amount of potential plugging material removed after treatment and by sustained and substantial increases in production that resulted.

Laboratory Results

Using the method outlined above the following results were obtained:

The sample was taken from bailings of a well producing from the Ranger Zone in the Wilmington Field, California. A volumetric analysis of these bailings showed:

	Per cent
Oil	28
Free water	6
Mud (—200 mesh)	20
Silt and sand (+200–16 mesh)	34
Coarse shale	12

In a series of tests, 20 gram samples were pressed in the screens and one each immersed in the following solutions, which were maintained at 160 F.

Solution	Per cent* cleaned	Results
Salt water 3 per cent by weight	13.5	"Per cent cleaned" caused largely by drops of heat-softened bailings falling off the screen each time sample was taken out to be weighed.
Chemical B-S (Chemical B dissolved in 3 per cent salt solution)	30	Cleanings consisted of oil that rose to the surface, and of finely divided mud, silt, and sand that settled to the bottom as bailings disintegrated and dropped through the screen.
Chemical C-S (Chemical C dissolved in 3 per cent salt solution)	82	Same as in (2) except action was much faster and continued at a more rapid rate. Remaining material held by screen was coarse shale with a small central lump of partially disintegrated fines.

* "Per cent cleaned" Expressed as a percentage, this is the ratio of the weight of the material actually passing through the screen during the test, to the total weight of the material which, as shown by the above analysis, could pass through the screen.

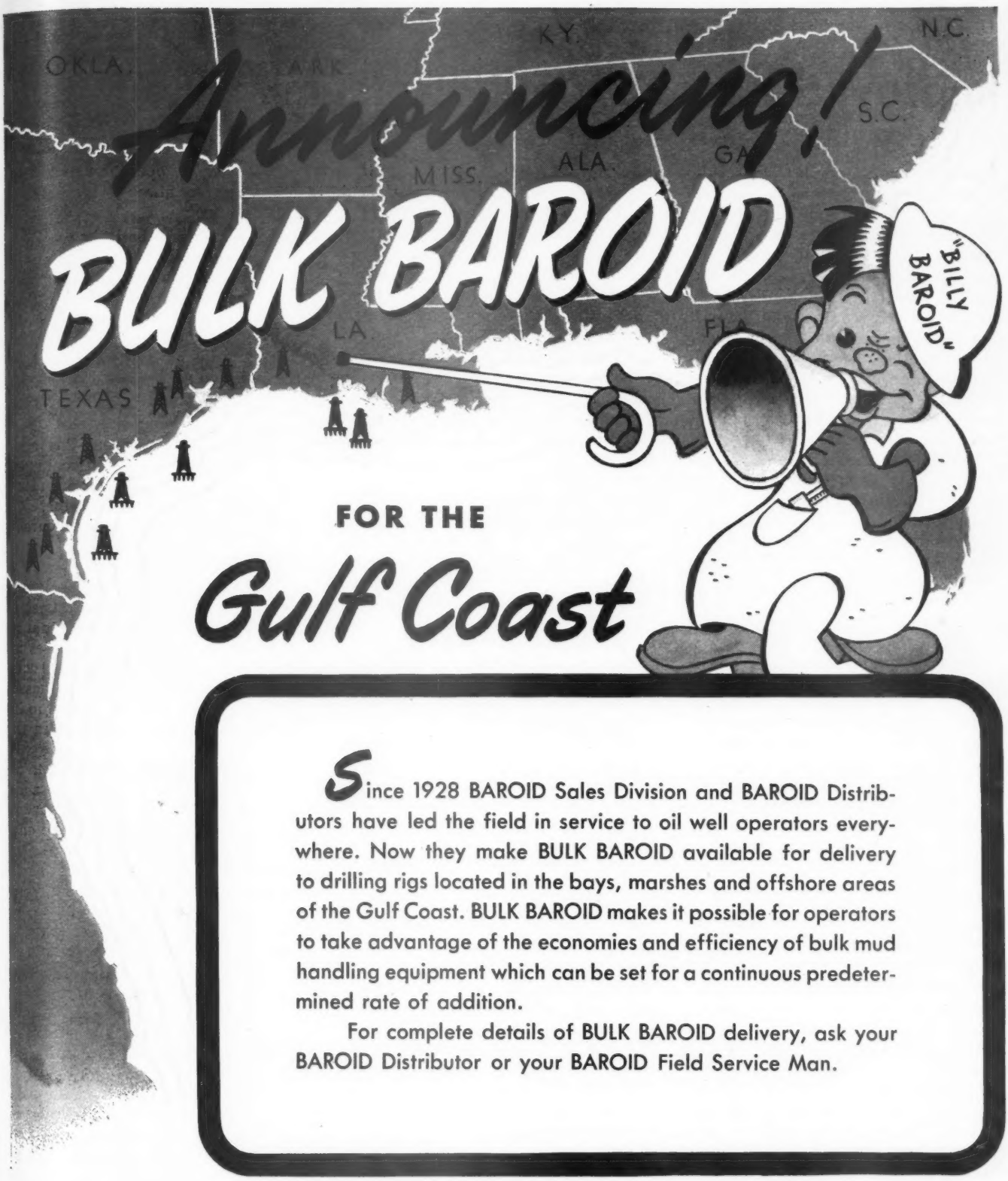
Standards Important

Unless test conditions such as temperature fluctuation, time out of bath and continuous periods of operation, are identical, caution must be exercised in comparing one set of test results with those of another set. Better comparison is possible through the use of a standard sample that is treated in the same standard solution during each set of comparisons. Changes in the amount of its cleaning will be in proportion to the changes in the test conditions.

With this note of caution, results are given for another set of comparative tests in which the solutions were raised from 140 F to 160 F during the test.

Solution	Per cent cleaned	Results
Salt solution 12 per cent by weight	8	"Per cent cleaned" largely caused by drops of heat-softened bailings falling off screen each time sample was taken out to be weighed.
Solution—3 per cent salt by weight and 9 per cent sodium bicarbonate by weight	4.5	Drains free. Appears to be coated.
Chemical D (Chemical D dissolved in 3 per cent salt solution)	74.5	Cleanings consisted of oil that rose to the surface, and of finely divided mud, silt and sand. Remaining material held by the screen was the coarse shale with a small central lump of partially disintegrated fines.

* * *



Since 1928 BAROID Sales Division and BAROID Distributors have led the field in service to oil well operators everywhere. Now they make BULK BAROID available for delivery to drilling rigs located in the bays, marshes and offshore areas of the Gulf Coast. BULK BAROID makes it possible for operators to take advantage of the economies and efficiency of bulk mud handling equipment which can be set for a continuous predetermined rate of addition.

For complete details of BULK BAROID delivery, ask your BAROID Distributor or your BAROID Field Service Man.

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THE BEST MUD WEIGHT MATERIAL

Improved Recovery of Petroleum Announced*

THE development, on pilot plant scale, of an improved technique for recovering nearly all the crude oil from the deeper reservoirs is announced by officials of The Atlantic Refining Company. They report that Atlantic's production research technologists have been intensively studying, for the past two years, the important problem of increasing the recovery of crude oil from underground reservoirs. This research has been conducted at the company's Production Research laboratories in Dallas, Texas.

In the early days of the petroleum industry, only about 35 per cent of the crude oil existing in the underground reservoir when it was discovered could be recovered and brought to the surface. During the last 10 years, as a result of improved methods of operation, the recovery of petroleum from the average reservoir has been increased to about 45 per cent.

The recoverable reserves of petroleum in the United States today total about 25 billion barrels. There remain in known fields, already tapped by wells, another 30 billion barrels of crude oil that is regarded as irrecoverable. There has been, up to now, no practical and economic method for bringing it to the surface. It remains a loss to the nation and to the petroleum industry.

Despite the petroleum engineer's best efforts to make the oil flow through the rock formation to the well bore and thence to the surface, over one half of the oil, in many cases, remains permanently trapped as drops of liquid in the fine pores of the reservoir rock.

The surface tensions between the boundaries of the different fluids present (oil-gas-water), coupled with the "capillary" effect of the fine pores and passages in the rock, result in the formation of separate small drops of liquid that are easily trapped and will not flow.

In operating a reservoir, using present techniques, the engineer carefully controls the flow of gas, water, and oil to get a maximum oil displacement with the aid of the native gas and water. He sometimes floods the oil bearing rock with air, gas, or water in a partially successful attempt at freeing some of the trapped droplets of oil.

The injection of gas into petroleum reservoirs to improve recovery has been practiced in two ways. It has been injected into the shallower crude oil reservoirs, which are under relatively low pressure, to help sweep out some of the liquid crude oil remaining trapped. In the case of the deeper "distillate" fields, gas produced is frequently returned to the reservoir to maintain the high pressure and prevent the distillate vapors from condensing to trapped drops of liquid.

Atlantic's scientists have discovered that crude oil and hydrocarbon gas mixtures, when under high pressure, possess properties previously unknown. With this knowledge, they have developed an operating technique that is proving, in the laboratory, to be a practicable means for recovering nearly all the oil from an underground reservoir. They have learned how to use high pressure hydrocarbon gases to increase the recovery of crude oil, and have demonstrated in laboratory displacement experiments the recovery of as much as 90 per cent of the oil.

The new operating technique involves the injection of a hydrocarbon gas into a reservoir containing crude oil under conditions that promote the mutual solution of the crude oil and the gas. The gas is injected so that it will flow through the reservoir and contact the trapped oil. The crude oil tends to dissolve in the high pressure gas and the gas tends to dissolve in the oil, swelling it far beyond the dimensions of the pores that imprison it. Under certain—and now known—conditions of pressure, gas composition, and crude oil composition, a single homogeneous phase is formed, which flows easily through the pores of the rock. Even under conditions when both gas and liquid phases still exist, the very much larger volume of the liquid phase results in a large increase in recovery. The liquid volume may increase as much as 30 times its original volume.

This process differs from present gas injection practices in crude oil reservoirs in that higher pressures are required to obtain these beneficial results. The important advance made by Atlantic's technologists is the knowledge of the physical principles involved and the resultant ability to:

(a) Forecast more accurately the magnitude of the higher recoveries of crude oil that can be realized by this technique.

(b) Plan the operation of a reservoir to attain maximum economic recovery of crude oil.

(c) Justify economically the use of large volumes of the proper hydrocarbon gas for this purpose as well as justify the expensive gas-compressing equipment required.

There may be justification, in some cases, for raising the pressure of a reservoir above its original pressure to obtain the maximum recovery.

The cost of recovering this additional oil will vary with different reservoirs at different depths and under a wide range of conditions and therefore cannot be estimated with any accuracy. The cost will not be trifling. It will likely be $1 or $2 or $3 per barrel. The market value of gas is increasing and large amounts must be placed back in the reservoir to gain the additional recovery of oil. The high pressures involved mean large and expensive compressing equipment and in many cases additional wells must be drilled to inject the gas at the right spot in the reservoir.

The amount of time required to recover substantial amounts of additional crude oil will of course vary in different reservoirs. It might be anywhere from 5 to 50 years.

Atlantic engineers are attempting to determine what portion of the country's oil reserves are susceptible to this new type of operation. The high pressures required will likely limit its application to the deeper fields.

Field tests using the new operating technique are being planned by Atlantic engineers, who are making a survey to determine the reservoirs best suited to its application.

This new development should make possible a very substantial increase in our country's oil reserves and is of major importance to the industry and to the public.

The announcement is made by H. W. Field, vice president of Atlantic and general manager of research and development, and L. Laskaris, director of crude oil production research and development, of Philadelphia.

This important advance in reservoir technology was developed by the staff of Atlantic's production research laboratories at Dallas, Texas, supervised by L. P. Whorton, Southwest director, and E. R. Brownscombe, associate director.

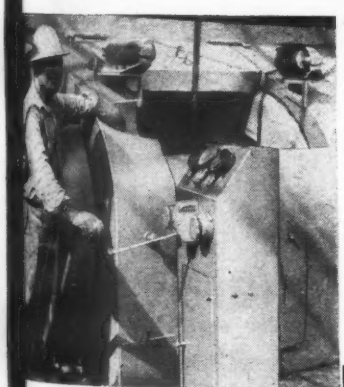
* * *

*This statement was released January 27, 1950, by The Atlantic Refining Company, 260 South Broad Street, Philadelphia, Pennsylvania.

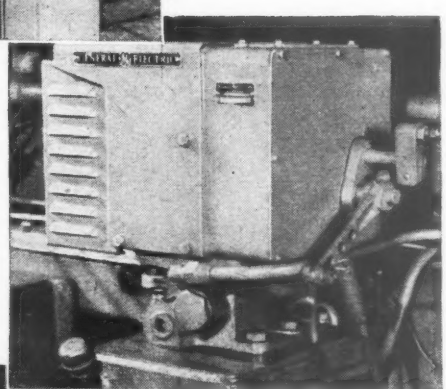
Fuel oil consumption is low on this G-E equipped, diesel-electric offshore rig. This is especially important because all required fuel oil must be brought out from the mainland.

With this floating rig . . . FUEL COSTS DIVE!

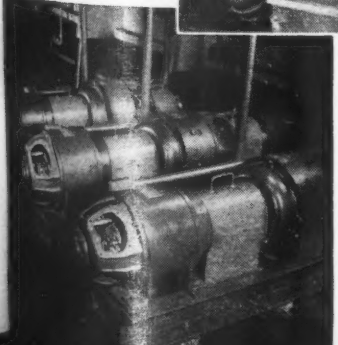
Another example of General Electric oil field electrification!



In a G-E drilling-rig drive, controls are centralized at the driller's position. Since they require only a few manual adjustments, the driller has more time for other duties.



Electro-hydraulic governor system acts as automatic "gear-shift" between d-c motor and engines. It prevents engine overloads, reduces fuel waste, cuts engine maintenance.



These G-E amplidynes, with their high amplification factor, use only a few watts to control main generator fields. When generators work in parallel, they automatically divide the load.

Here—along the Louisiana mainland—is one of the largest diesel-electric rigs ever built for drilling in shallow water. It's operated by a completely co-ordinated General Electric drive that provides flexible operation, lengthens engine life, lowers maintenance costs. And because diesel-electric drilling consumes only about 1/20th the fuel oil required by a steam-engine rig, the problem of over-water fuel transportation is minimized.

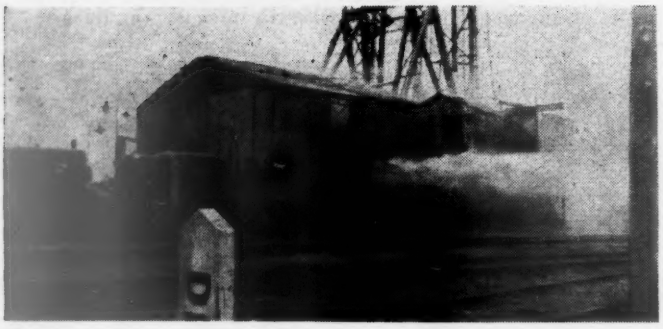
Engines protected against overloads!

Key to this drive's success is an electro-hydraulic governor which gives automatic diesel-engine speed and load control. This service-proved G-E device 1) protects diesel engines against damaging overloads, 2) saves fuel and unnecessary engine wear by enabling the engines to run at economical low speeds when desired instead of full-rated speed at all times, and 3) provides for engine paralleling without the operator's attention.

Deep well drilling—on land or sea—is only one of many oil-field jobs you can do more efficiently electrically—with the right G-E equipment. There's an oil production specialist in your local G-E office, ready to give you advice and help on all your electrical problems. Why not call him? *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

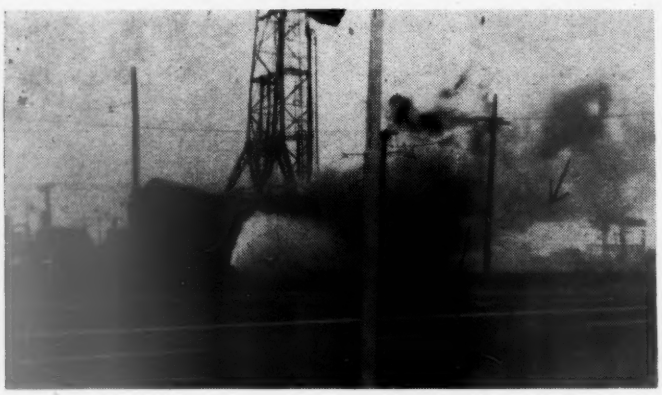
GENERAL ELECTRIC

661-2



Ten minutes after blowout at 8:30 a.m. well blew mud and water out of casing in the short interval between removal of blowout equipment and before tubing could be landed. In just a few minutes well would have been safely closed in.

The five men in the crew, out of camera range, wiped mud out of their eyes. They were covered from head to foot. None suffered more than slight burns. The fire did not go up into the derrick because of the heavy flooring.



Here the flames looked like a giant blow torch. The flame was about 75 ft long and only 10 ft high and the noise was terrific. Rotary mud in the tank at right was boiling and the tank was vibrating. You had to shout to be heard. Snapshot was made from across Highway 101.

Firemen have thrown up sheet iron shield, aiming water hose from hole in center. The trolley wires were still up and were alive although every one thought they were dead by this time. The fire had been going 35 minutes and all the trolley wire support poles were either on fire or smoking.

Oil Well Fire Caught by Camera

Photographic Record Shows How Fire Is Fought and the Dangers That Beset the Fighters

RICHARD SNEDDON†

FOR many years Frank Austin* had carried a loaded camera in the glove compartment of his car, hoping that one day sooner or later he might be first on the scene of some spectacular event and get what the news boys probably call a "photographic scoop." But the very possession of the camera seemed to exercise a sort of spell that made all the big things happen too soon or not soon enough. Frank's car invariably arrived at the scene of the accident just as the last bit of debris had been cleared away. If a fire happened to blaze out along his course of travel it was his usual luck to come into the vicinity after all the barricades had been erected, and have some cop tell him, "Sorry, son, you can't go thataway, they's havin' a fire. Better take the detour, it's just 20 blocks or so outa your way!"

But patience is a virtue and it has

†Pacific Coast Editor.
*California Production Service, Inc.

EXCLUSIVE

2590 *extra barrels every month for 6½ years*

with

BLACK MAGIC

OIL BASE DRILLING FLUID

On October 10, 1940, the first Specific Productivity Index was .00611. On April 11, 1947, 6½ years later (the date of the last reading), the SPI was .00132. It had dropped to 21% of its original pressure. Total production during this 78 month period was 256,000 bbls., an average of 3285 bbls. a month.

The first SPI taken on September 24, 1940, was .00789. On August 19, 1947, the SPI was .00294. In 83 months it had declined to 37% of its original. Total production was 487,500 bbls., a monthly average of 5875 bbls., an increase of 2590 bbls. every month over Well A.

NOTE THE SIMILARITY OF THESE OFFSET WELLS

	WELL A	WELL B
Sand Thickness	180 ft.	190 ft.
Average Sand Permeability	115 md.	105 md.
Static Pressure	3135 psi	3100 psi
Millidarcy feet of sand	20,700	19,950

* The oil base mud used in this well contained air-blown asphalt and was mixed with a refined type oil. After several improvements this mud became known as Black Magic.

BLACK MAGIC ASSURES MAXIMUM RECOVERY

These wells were produced under proration conditions and represent normal depletion practices. In spite of the fact that Well A flowed an average of 3285 bbls. monthly, it still was producing far below its ultimate potential due to Jamin action (water blocking), the result of drilling into the production zone with water base muds. The difference in the size of Wells A and B proves beyond question that water blocking damages a well permanently, hastens the day it will be shut down.

Black Magic with a filtrate loss of zero cannot possibly mud off or water block the oil sands. Black Magic deposits a thin mud cake that readily disintegrates when displaced by crude. It helps instead of hinders production and on occasion has made commercial producers out of dry holes. For full information write for paper "What Happens Tomorrow?"

OIL BASE, INC., 130 Oris Street, Compton, Calif.

Bakersfield * Long Beach * Ventura

EXPORT: Shaw R. Smith, Caracas, Venezuela; G. Saavedra E. Mijes, S. de R.L. Mexico, D.F.

BLACK MAGIC is represented east of California by:

CORE LABORATORIES, INC., Dallas, Texas

Houston, Corpus Christi, Shreveport, Tyler, Lafayette, Natchez, Oklahoma City, Denver, Midland, Abilene, Ranger, Wayland, Calgary, Edmonton

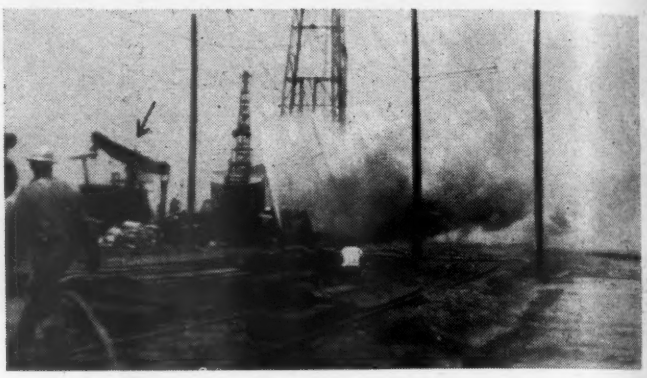
CORE LAB

PETROLEUM RESERVOIR ENGINEERING

its inevitable reward. Frank finally had his moment of triumph at Huntington Beach one day last summer when he ran smack into an oil well fire just in its incipient stages. He immediately put his trusty camera to work, and as his company car was well known to all the officials in the area, he was permitted full freedom of ingress and egress, of which he took full advantage. The results of this special privilege are to be seen in an interesting chronological series of photographs, several of which are reproduced here. They show the progress of the fire almost from the initial ignition to the ultimate quenching.

The well blew out at about 8:25 a.m., and caught fire within two or three minutes from some cause that is so far undetermined. Fortunately the

Some oil began to flow with the gas and spectators backed up. The trolley wires were down at last. When the live wires hit the tracks there was some lively writhing and the firemen were dancing, too, away from the deadly wires. Arrow points to walking beam of adjacent well.

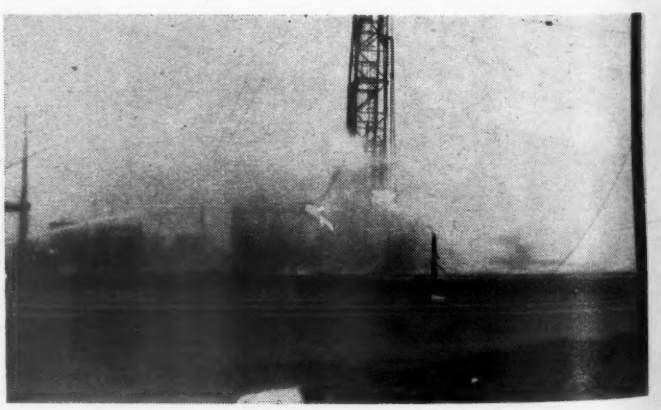


A crane was moved in on the least dangerous side of the fire and everything loose and light enough, oil drums, butane tanks, machinery, was pulled away. Pieces of cement chipped out and sprang high into the air every time a splash of cold water hit the cement pavement.

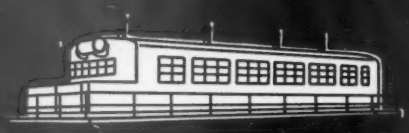
A heavy head of oil has just splashed against the underside of the steel sub-base. The flames were mixed with the white steam made by water hitting the red hot machinery. Fire could be worked on only from two sides, directly in front of the camera and to the left.

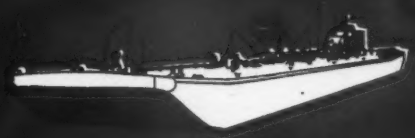
The fire began to come through the sub-base and floor. It grew higher and became louder—sounded like a squadron of jet planes. The zinc galvanizing on the derrick legs grew white hot. The cameraman had to back up for this one as fire began to come through the sub-base.

Captain Bill Rardin of the Huntington Beach fire department, a neighbor of the cameraman. Rardin once said his department could have white smoke coming from Vesuvius in 30 minutes if there was no oil in the Volcano.



A crew of men under the engine house to the left were loosening bolts and turnbuckles so that more machinery can be dragged away. They were regular company employees who, on their own, went under there to help.



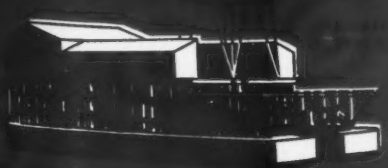


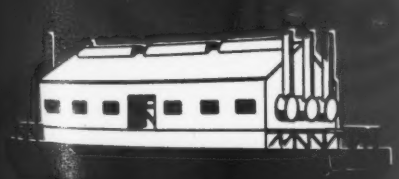
Levingston

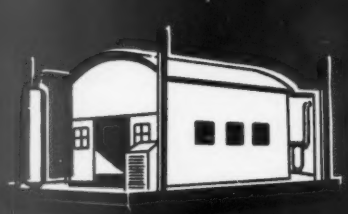
BUILDERS OF FINE SPECIALIZED MARINE EQUIPMENT FOR THE PETROLEUM INDUSTRY

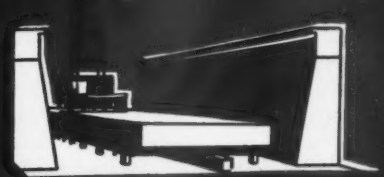
Levingston

SHIPBUILDING COMPANY • ORANGE, TEXAS









Well again started making oil heads and was very hot. Derrick legs on this side soon buckled and dropped the derrick. Station attendant closed up the place at right, locked it, and was out of the way in two minutes.

Derrick legs buckled slowly. Cameraman waited three minutes in one spot to get the above picture. Two news photographers had joined Austin by this time and the falling derrick was spotted by three cameras.

Some idea of the heat can be gained from this scene. Firemen weighted the hoses down with sand bags and backed away to cool off. Everything in the vicinity of the fire was splattered with 90-lb rotary mud.

Arrow points to walking beam of an old well that was used to kill the one burning. A welder ventured under the engine house to cut off some of the larger fittings to save time. Others took off loose bolts.

crews managed to escape without serious mishap, although they did receive involuntary hair singes and badly scorched faces. It was a new well they were working on, and they had just run tubing to put it on production. The blowout equipment had been stripped off while the tubing was being landed, and consequently the well was beyond control from the minute it blew out.

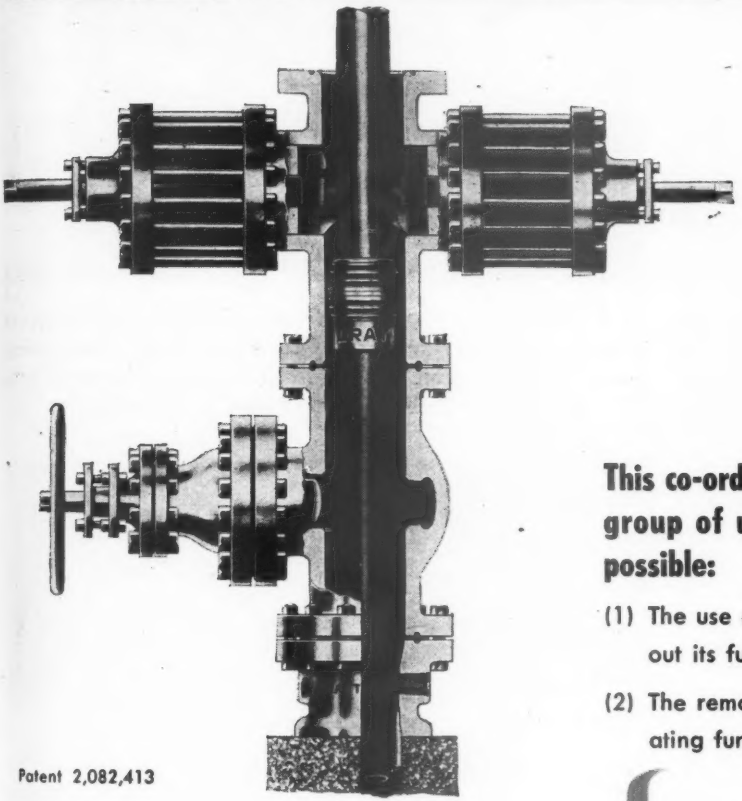
Our wide awake news cameraman had already exposed one frame within five minutes of the first alarm, before the flames had assumed very exciting proportions, and before the fire hoses had been laid. A second shot caught the beginning of the fight, with water being directed on the blaze. Meantime the dimensions and violence of the fire increased rapidly because of the correspondingly rapid increase in the volume of gas being blown out. Subsequent snaps show the flames projecting 75 ft outward from the derrick floor. The floor and substructure had the effect of deflecting the flame in rather a peculiar manner.

In due course the fire came through the rig floor and up into the derrick, setting the rotary hose aflame. Trolley wires fell every few minutes, hampering the work of the fire fighting crews and adding an extra element of danger to their already hazardous undertaking. At first the effluent of the well was entirely gas, but after it had blown for about an hour, it began making enough oil to produce a very hot fire. It was perhaps lucky that the complete flow was being consumed as it was produced, because the well was situated on a 40-ft bluff about 100 ft from the ocean. Soon after the oil started flowing by short heads the two derrick legs on the lee side buckled and the entire structure fell on to the highway.

Later pictures show the battery of cement and mud trucks that were brought to the scene and rigged up in the hope of smothering the fire with rotary mud, but the method had little effect because of the considerable quantities of gas that were being blown out. It was abandoned as too dangerous anyway, since there was still plenty of hot steel from the rig lying at the casinghead. With no available means of shutting off the gas, it would obviously be decidedly impractical to put out the fire without stopping the flow.

The well was finally controlled by setting up a small portable derrick on an adjacent well. Rods and tubing were pulled, and a plug was set in the casing below the level from which the burning well was producing. The casing was then perforated at the level of the producing formation. Salt water was thereafter pumped into the zone through the perforations, with the use

GRAY SYSTEMS OF WELL CONTROL INCLUDE THESE DEVELOPMENTS



Patent 2,082,413

THE WHOLE IS THE SUM OF ITS PARTS

This "ASA Series" system of well control combines:

(1) The boll weevil system of suspending and sealing the outside of an inner string, together with provision for controlling flow through the inside; and

(2) The use of control equipment of a size related to and balanced with a given size casing and other equipment.

This co-ordination of an otherwise heterogeneous group of unrelated parts and fittings makes possible:

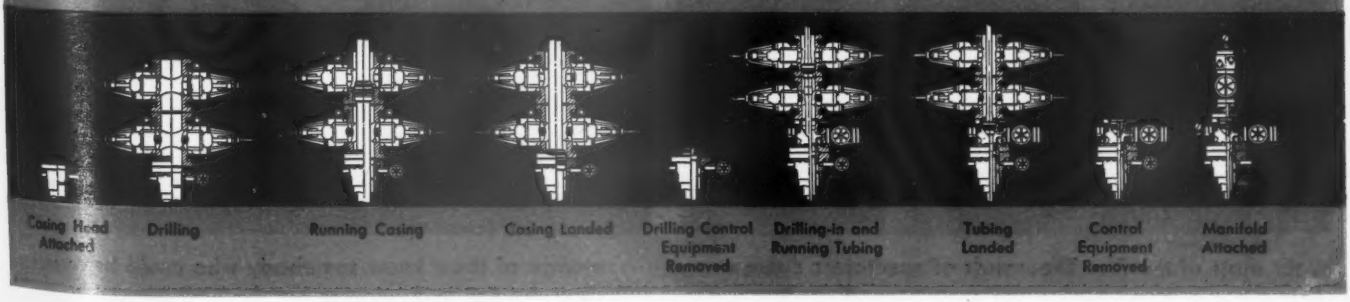
(1) The use of a wide choice of control equipment throughout its full operating function; and

(2) The removal of said equipment when and as said operating function is completed.

This method provides for the use of parts and fittings as a co-ordinated "whole." It avoids the inherent weaknesses which exist and accompany failure to study the whole of a problem in addition to the parts thereof.

GRAY TOOL COMPANY
HOUSTON

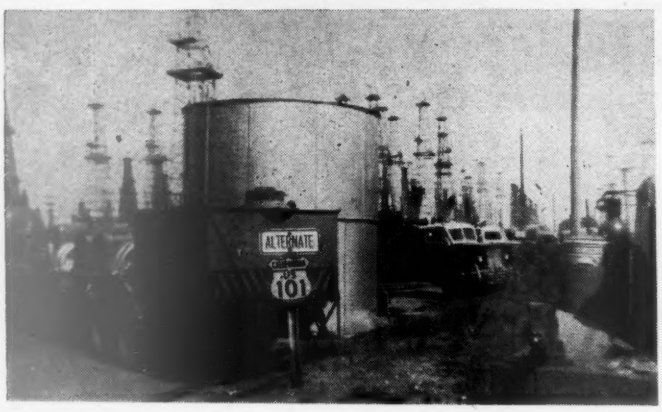
Rocky Mountain Representative: CARL MOULDEN, P. O. Box 1890, Casper, Wyoming



of a cementing truck. After about five hours of this treatment, the flame had diminished to a small torch, a crane moved in close with a long spearlike tool, fitted with a packer and slips. The firemen stood by with fog nozzles, and when all was in readiness fog spray was directed at the casinghead while the crane operator dropped the packer tool into the casing.

That did it. But in the meantime Frank Austin had accumulated the extensive library of progress shots already referred to. The fire eventually burned for three and a half days before it was subdued. And now Frank is a little more optimistic as he drives around the fields with his camera reloaded, and reposing again in the glove compartment of his automobile.

* * *

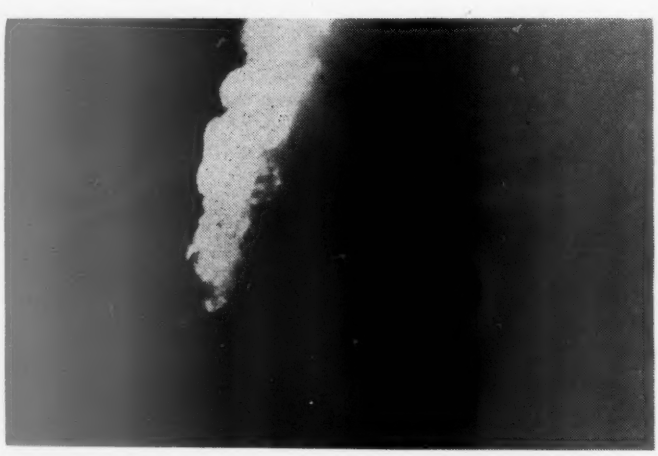


Cementing rigs from as far north as Ventura lined up and connected with 6-in. pipe to pump rotary mud to fire. All that happened was 2 or 3 in. of mud all over the lease. Decided fire would be less dangerous than escaping gas.

Rods and tubing were pulled from old well and a packer plug set below gas zone. Gas zone was perforated, tubing rerun to perforations and cold salt water was pumped into gas zone. In matter of hours fire was weakened.

View from the crane that was later used to set control head in casing after fire was out. It burned three days. In foreground equipment that had been dragged from fire area. Even this far away it was hot.

A plane from one of the news services flew back and forth above the fire and took movie films of the burning well. The Pacific coastline seen below the plane was only 40 ft from the site of the oil well.



Night shots of the fire. Thousands of spectators came every night for the three nights the well burned. A large percentage of them knew somebody who could have put out the fire in 5 minutes but the well burned on.

Calibration of Capillaries for Permeability Apparatus

J. W. YOUNG,* H. M. MILLETT,* A. G. A. PIERCE†

In operations in Imperial Oil Limited, permeability of core samples is measured by the API Code 27, using air flow. As a matter of routine in the study of limestone formations, full size cores are used, these cores being 3.5 in. in diameter and up to 6 in. in length. At the same time a number of small core plugs (⅝-in. diam and ½ to 1-in. length) are used in cases where the original core has been so badly fractured that full size samples cannot be obtained. The method of using large core samples has already been presented in a previous paper by Gibbs, Phillips, and Piercey [1].

As the measurement of gas flow is one of the basic functions in determining the permeability, whatever gas metering instrument is used must be calibrated accurately. The present paper describes the method of calibration that has been developed for indicating flow meters of orifice or capillary type. So far as the authors are aware, this test equipment design is original, although the various methods have been applied generally in industry.

*Engineers for Imperial Oil Limited, Calgary, Alberta, Canada.
†Chief Chemical Engineer, Madison Natural Gas Co., Turner Valley, Alberta, Canada.

[1] W. W. Gibbs, R. S. Phillips and A. G. A. Piercy, "Analyzing Large Section Cores." *The Petroleum Engineer*, May, 1949.

Theory

The most complete record of calibration of low range flow meters is that of Benton. It is pointed out by this author that a flow in a capillary tube may follow either a viscosity equation, an orifice plate equation, or a transition range between the two, depending on the character of the flow meter used. In cases where the flow in a single tube is in the transition region the meter must be calibrated over the whole range. This procedure was followed in all the calibrations reported herein, as the widest range possible was desired.

The equation for viscous flow in a fine capillary is given by Poiseuille's Law:

$$dp = \frac{32\,\mu V L}{g\ D^2} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Where:

dp = pressure differential,
μ = viscosity of gas,
V = velocity of gas in tube,
L = length of tube,
g = acceleration due to gravity,
D = diameter of tube.

In general and wherever possible, capillary rather than orifice flow meters have been used. Temperature variations have a marked effect on the flow rate in the viscous region, but have little effect in the turbulent region. However, it may be shown that when a capillary flow meter is in use (the gas flow being viscous in both capillary and core) that temperature corrections are eliminated in the calculation of permeability. This is demonstrated in the following equations:

$$K = \frac{Q}{T} \times \frac{V}{A^2} \times \frac{2P^2}{P_1^2 - P_2^2} \times Z \times 1000 \quad . \quad . \quad . \quad (2)$$

Where:

K = permeability (millidarcys),
$\frac{Q}{T}$ = gas flow rate at $P = P_2$ (ml/sec),
A = mean area of core (cm^2),
V = volume of core (cm^3),
P_1 = input pressure (atm),
P_2 = output pressure (atm),
Z = viscosity of air (centipoises).

Equation (1) for viscous flow in a fine capillary can be changed to the following form for any one instrument:

$$\frac{Q}{T} = \frac{CM}{Z} \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

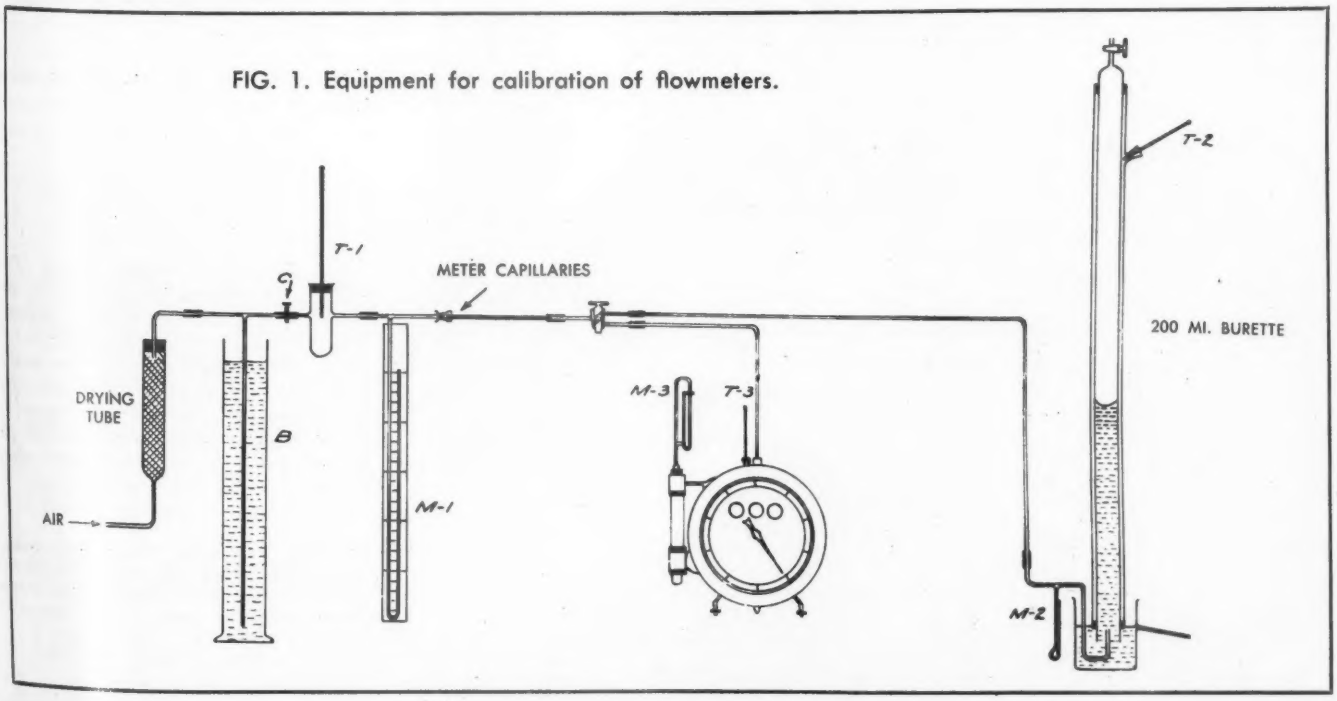
Where:

C = constant of the instrument,
M = differential pressure on the manometer.

Assuming that a core cut with a

EXCLUSIVE

FIG. 1. Equipment for calibration of flowmeters.



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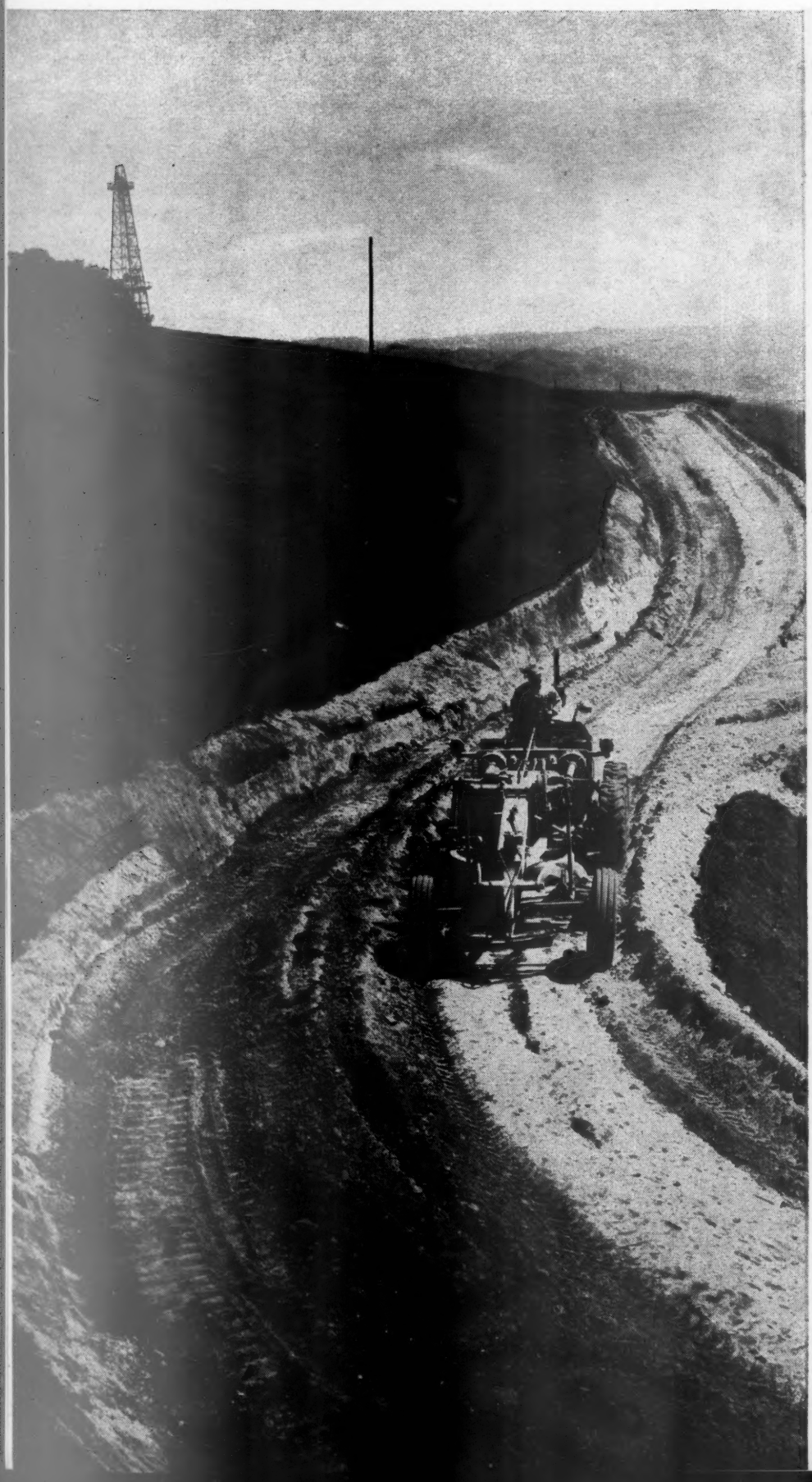

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•

Standard "Caterpillar" Diesel Motor Graders are priced as follows: No. 12, $10,920; No. 112, $9545; No. 212, $6435, all prices f.o.b. Peoria, Illinois, subject to change without notice.

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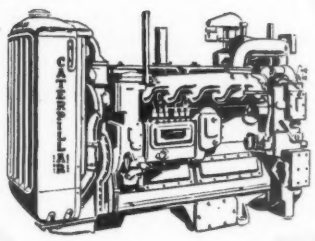
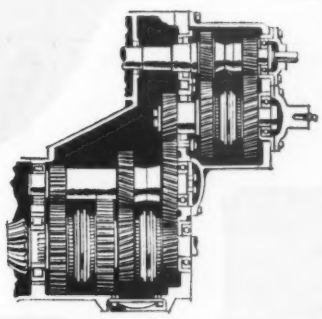
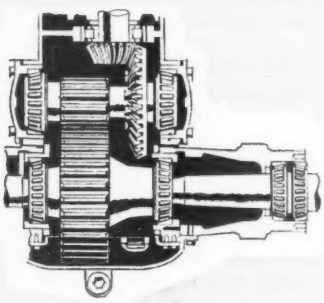


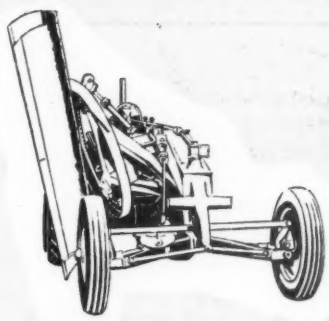
ENGINE. The dependable, heavy-duty all-"Caterpillar"-built No. 12 Motor Grader engine is designed to function as a unit with all other parts of the machine. It has ample speed and power plus ruggedness to stand up on the job. Solid aluminum alloy main and connecting rod bearings are important reasons why these engines are so long-lived.



TRANSMISSION. The "Caterpillar" No. 12 Motor Grader transmission is a *constant-mesh helical gear transmission* specially designed and fitted to heavy-duty motor grader use. Yet it shifts with "pleasure car" ease. Typical of "Caterpillar" quality is the independent gear-type lubricating oil pump which keeps every transmission gear bathed in a full supply of filtered oil.



FINAL DRIVE. Heavy-duty engine and transmission require a rugged but simple final drive system to keep the motor grader at top working efficiency. Engine horsepower is converted into maximum tractive effort and earthmoving volume through this simple, sturdy system. Tapered roller bearings throughout keep friction losses at a minimum.



BLADE MECHANISM. The "Caterpillar" Motor Grader frame and blade system fully matches the sturdy in-built quality of the "Cat" Diesel Engine, transmission and final drive. Blade working positions like the one shown here can be made by the operator without leaving his position at the wheel. Mechanical-powered controls are unaffected by temperature changes.

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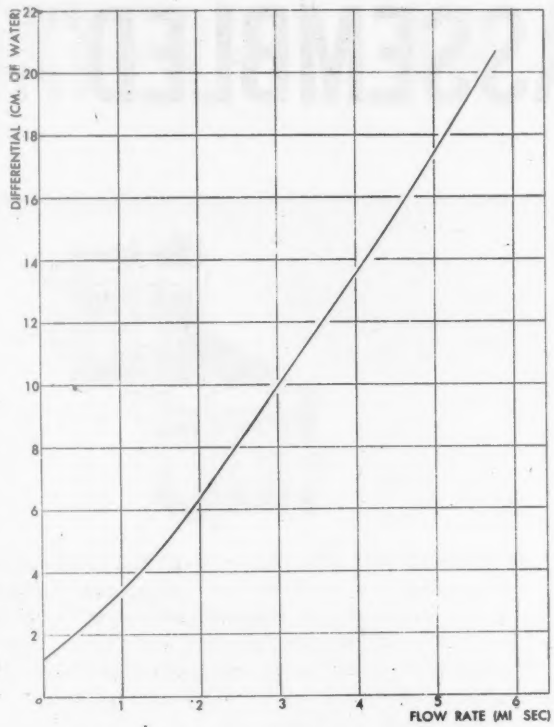

FIG. 2. Calibration of Capillary No. 5.

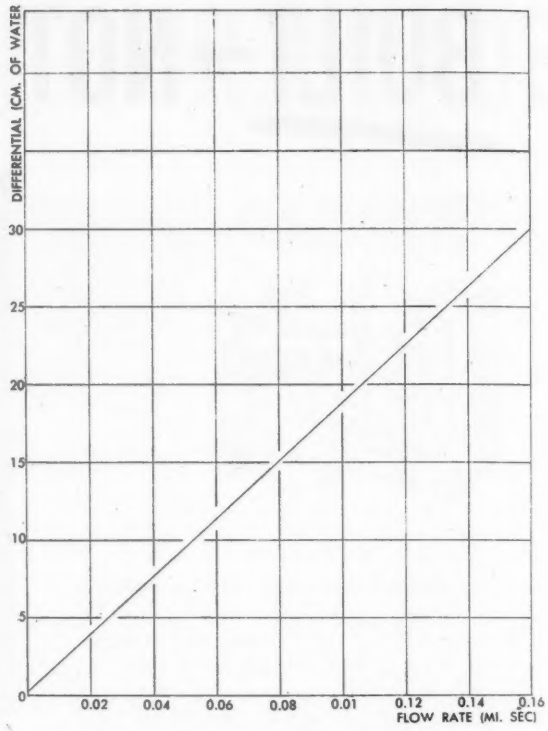

FIG. 3. Calibration of Capillary No. 11.

standard diamond drill has a reasonably constant cross-section, and inserting values from equation (3) into equation (2), the permeability can now be expressed by:

$$K = \frac{1000\,C}{A^2} \times \frac{2P_2MV}{P_1^2\text{-}P_2^2} \quad . \quad . \quad (4)$$

The fraction $\frac{1000\,C}{A^2}$ remains constant for any one flow meter, and any one series of cores prepared from a calibrated core drill. It will be noted that there are no viscosity terms in the equation, and hence there is no temperature correction, this having been eliminated in the final equation. This simplified equation permits the use of nomographs for calculation of permeability as will be described in a later paper from this laboratory.

Calibration Method

The apparatus used is set up as in Fig. 1. Air from a blower is kept at a constant pressure by the bottle B, and its flow rate adjusted by the screw clamp C. The manometer M-1 measures the flow rate through the capillary, the fluid consisting of water to which a trace of a wetting agent such as "Aerosol" has been added. Depending upon its flow rate, the discharged air may be measured by the wet test meter, or by the 200 ml eudiometer-burette. In the latter case, the pressure is read on Manometer M-2. Temperatures are read on thermometers T-1, T-2, and T-3.

In running a test, a suitable volume (usually that collected in 20 seconds to three minutes) is measured in the burette, or taken on one revolution of the wet test meter. Times are measured by a stop watch.

Gas volumes as measured in the burette are, of course, read at two different heads. For each burette, a calibration curve is prepared, relating the volume reading to the equivalent millimeters of mercury to be subtracted from barometric pressure. Calculations are applied to the burette readings as noted.

As the air in the flow meter is dried, the volumes read must also be corrected for water vapor. A specimen calculation of an actual run is as follows:

Capillary No. 5
Barometric Pressure mm.....672.0

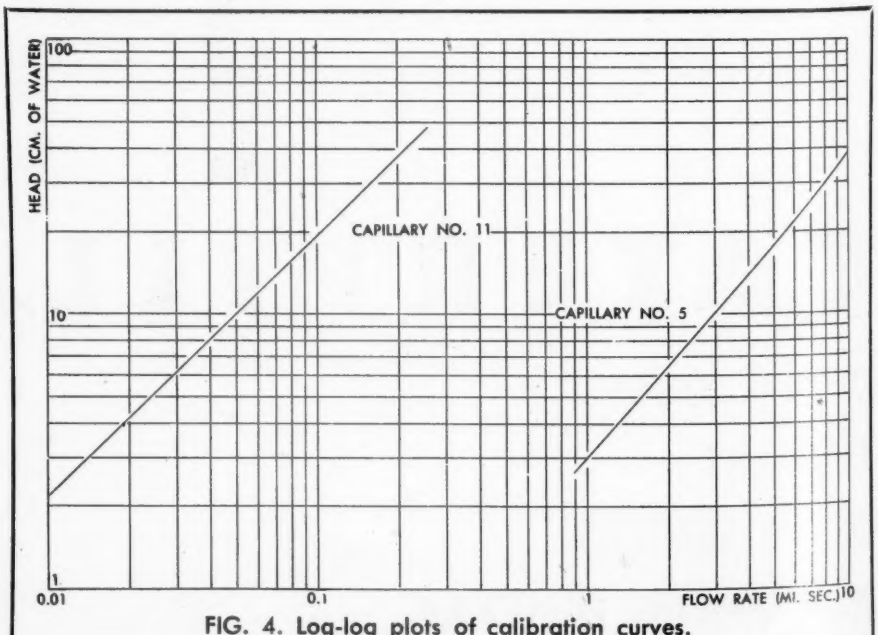

FIG. 4. Log-log plots of calibration curves.

Manometer M-1 start 4.86
finish 4.86 .....aver. 4.86
Temperature:
T-1 22.7°C .....295.7°K
T-2 22.5°C .....295.5°K
Air Volume:
Start 36.0 ml. Finish 26.0 ml.
Volume of air.....90.0 ml
Time .....58.9 second
Flow rate = ml per second.....1.53
Manometer M-2 mm of water....3 mm (not significant)
Pressure corrections (from calibration curve for burette)
Start 36.0 = 46.2 mm Hg.
Finish 126.0 = 21.0 mm Hg.
Mean = 33.1 mm Hg. 33.1
Vapor Pressure Correction (22.7 C from vapor pressure-temperature curve) 20.5
Total 53.6
Partial pressure of air = 672.0 − 53.6 = ...618.4
Corrected barometric pressure 672.0 + 3.6 (M-1 equivalent) = ...675.6
Gas volume at meter inlet =

$$1.53 \times \frac{618.4}{675.6} \times \frac{295.7}{295.5}$$

= 1.40 ml per second

Results

Some 20 capillaries have been calibrated by this apparatus covering flow rate ranges of 0.01 to 100 ml per second. In Figs. 2 and 3 there are given duplicate calibration curves plotted on plain co-ordinate paper for two capillaries. It will be noted that in capillary number eleven the relationship of differential to flow is practically linear while in capillary No. 5 it is curved.

These two curves are repeated on log-log paper in Fig. 4 in which it is demonstrated that capillary 11 follows the viscous flow equation and capillary 5 is fairly close to an orifice type of flow.

A method for the calibration of capillary flow meters has been described in which the use of very convenient apparatus is given in some detail. In further papers from this laboratory, the applications of these flow meters to rapid permeability determinations will be described.

Acknowledgment

The development of this apparatus was originally completed while the senior author was attached to the Madison Natural Gas Company in Turner Valley. The method has been adopted by the Imperial Oil Company Laboratory. The authors wish to express their appreciation to their employers for permission to publish this paper.

* * *

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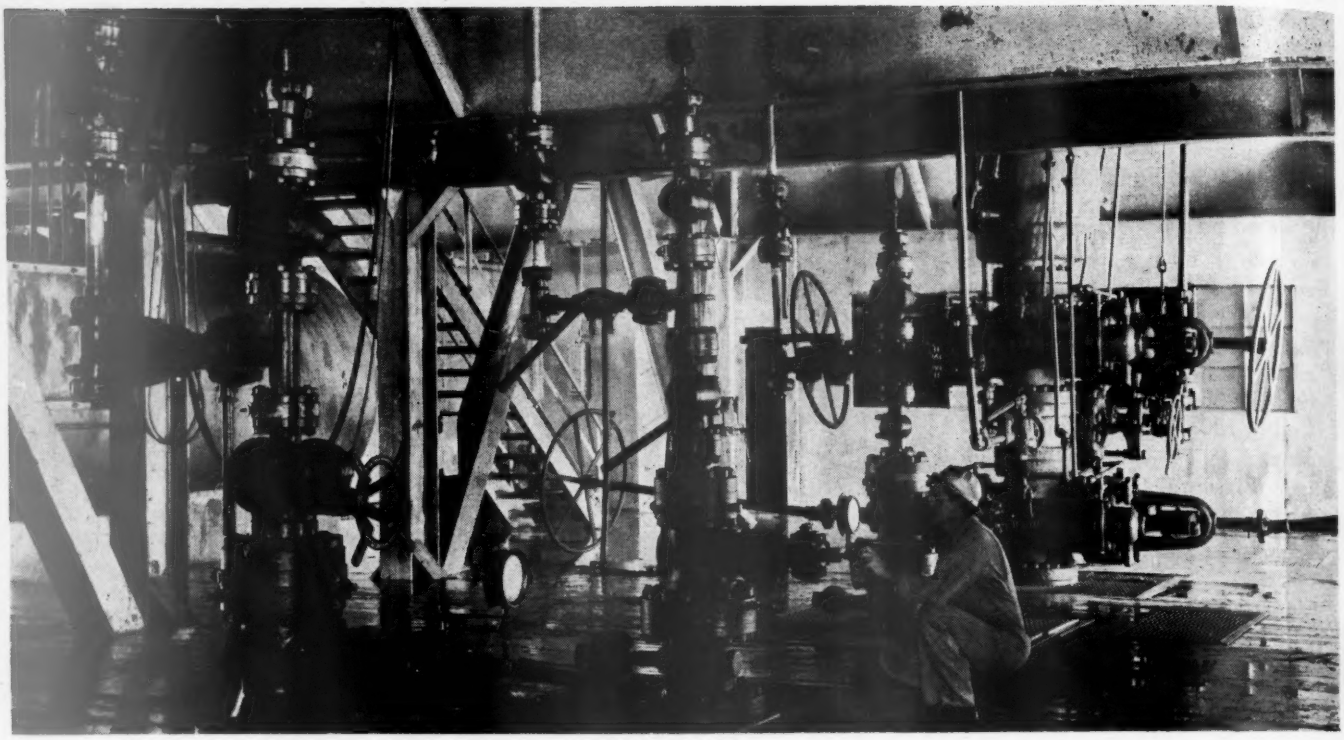


Christmas trees of three producing oil wells beside blowout preventers on Humble's offshore drilling platform.

Dry Ice Prevents Blowout

AN UNUSUAL use for dry ice was applied recently by production men of Humble Oil and Refining Company in controlling an oil well seven miles offshore in the Gulf of Mexico. The well, completed in August, 1948 as the first producer on Humble's $1,250,000 marine drilling platform off Grand Isle, Louisiana was being worked over when oil and gas under pressure from below began threatening to blow out, endangering two other oil wells on the platform and the platform itself. The threat was controlled by using dry ice to freeze a solid plug of drilling mud in the drill pipe until a positive shut-off could be installed. The workover job on the well was successfully completed and the three wells on the platform are now producing a combined allowable of about 700 bbl per day.

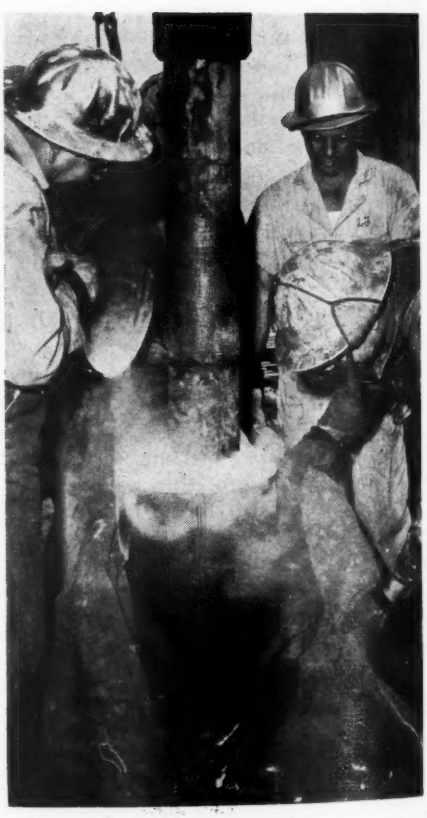
During workover operations, the pressure of oil and gas in the reservoir 8640 ft down overcame the weight of the drilling mud in the hole, forcing the mud out the top of the well. The three sets of blowout preventers were closed to seal the space between the well casing and the drill pipe, and the 540 ft of drill pipe in the hole was capped by the kelly joint in the normal fashion for drilling. This sealed the well, and the pressure at the surface climbed to 800 psi.

The driller's problem was to add more drill pipe to the drill string, to move the bottom of the pipe to the bottom of the well where heavy drilling mud could be pumped in to control the pressure of the oil reservoir. This meant unscrewing the top section of drill pipe under pressure.

Twice fresh water was pumped into the drill pipe and dry ice was packed around the outside of the pipe. Each time oil and gas bubbling up from below kept the water from freezing.

On the third try, viscous bentonite (clay) mud was pumped into the drill pipe and pulverized dry ice was tightly packed in a can around the drill pipe. After two hours during which the ice was constantly tamped tight, the mud was frozen solid, making an effective seal.

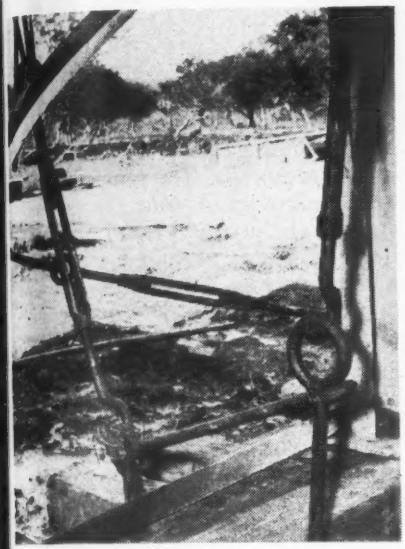
The top joint of pipe was then unscrewed and a joint with a positive shut-off plug was installed. The remainder of the drill pipe was made up and lowered through the blowout preventers to the bottom. The plug in the drill pipe was then drilled out and heavy drilling mud was pumped in to control the reservoir pressure and quiet the well. * * *



Crew packs pulverized dry ice around drill pipe to control well.

A Tie-Down Anchor That Checks Vibration

Use of turnbuckles and heavy eyebolts to tie the drilling engine to the rig is fairly common, a U-shaped iron being forged from 1½-in. rod to enclose three sides of the foundation timber and afford hitches for the



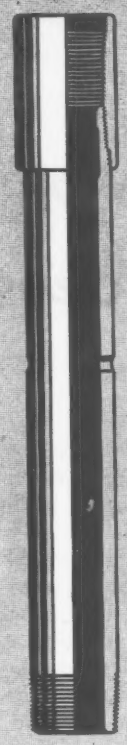
Anchor for drilling engine to cut down vibration, which may cause crystallization.

turnbuckles. One contractor, using this method of anchoring the drilling engine, found that vibration caused crystallization of the steel rod at the sharp bends. To check the damaging vibration, he improved the shape of the anchor. To the side of one eye was welded another section of the same 1½-in. material. This terminated in a hook, and was just long enough to engage the shank of the opposing leg of the U. The eye of the leg restrained the hook from rising, while a stop of the same material, welded to the upright, prevented motion downward.

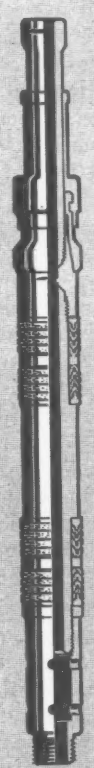
The base timbers were slipped through the loop thus formed, and the longer leg sprung inward until the hook engaged the upright. Then, when tension was applied through the turnbuckles, the unit pulled out to the extent permitted by the cross member. So long as the turnbuckles were tight, the angular pull was checked by the cross bar, and all vibration and off-line loading intercepted before the bends at the bottom of the U could be damaged.—M.H.P. * * *

AAODC Plan Meet

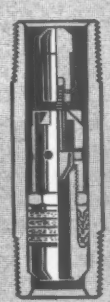
Directors of American Association of Oilwell Drilling Contractors will hold their second quarterly meeting for 1950 in Corpus Christi on April 7. Headquarters will be in The Robert Driscoll Hotel.



Otis Side-Door Choke Landing Nipple



Otis *Removable* Side-Door Choke



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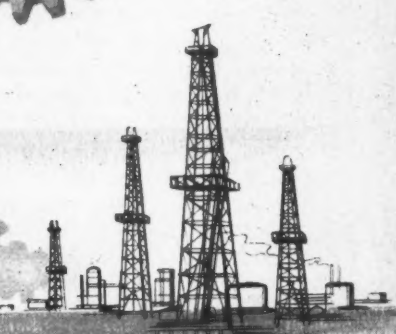

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Phase Behavior of Natural Gas and Condensate Systems†

J. PAUL SLOAN*

PROBABLY as good a place to begin a discussion of condensate production and behavior would be to state that a condensate reservoir is a petroleum reservoir, or perhaps better still, a hydrocarbon reservoir. A great deal of confusion in thinking has resulted from the arbitrary classification of hydrocarbon reservoirs as gas reservoirs and as crude oil reservoirs. Actually, each of these categories is not a broad group, but is a very narrow, highly specialized case. There are few gas reservoirs that do not produce some liquid products at the well head or contain some trace of a liquid phase in the reservoir, or both. Likewise, few indeed are the reservoirs that produce liquid hydrocarbons or "crude oil" without some solution gas. We get a much clearer picture of the problem if we think of all the hydrocarbons, beginning with the lightest, methane, to the heaviest asphaltic substances as a series of compounds of the same family, consisting of carbon and hydrogen in a limitless number of proportions. A hydrocarbon reservoir then, is a porous section of the sedimentary crust of the earth containing a group of hydrocarbons, which is probably unique and whose overall properties such as reservoir phase, gas:oil ratio, gasoline content, viscosity, etc., is the direct result of this composition, together with the temperature and pressure that happens to exist in this particular spot in the porous sediment.

It is now easy to conceive of any possible combination of these hydrocarbons in a given reservoir, and it is also easy to visualize a reservoir fluid whose physical state may range from a completely dry gas in the reservoir, shading gradually through the wet gas, the condensate, the critical mixture, the highly compressible volatile liquid, the more stable light crude oil whose color is beginning to darken, the heavier crudes with decreasing solution gas, and ending with the semi-solid asphalts and waxes with no measurable solution gas.

The condensate reservoir that is the topic under discussion, is therefore first a hydrocarbon reservoir. Due to the composition and proportion of the individual hydrocarbons in the mixtures the content is gas phase at the temperature and pressure of the reservoir. The composition is such, however, that a reduction of pressure at reservoir temperature will allow the precipitation of portions of the heavier hydrocarbons as a liquid, these fractions in turn becoming a solvent for varying proportions of the remaining gas phase hydrocarbons, the total resultant liquid being referred to as reservoir condensate. It is this habit of liquid precipitation that makes a problem child of the condensate reservoirs. Substantially all of the pentanes and heavier hydrocarbons may be recovered from a reservoir of this type if the pressure of the mixture is maintained by injection of dry gas, or "cycling." This procedure, however, is expensive, particularly in the high pressure reservoirs. It may also be assumed that a considerable portion of this material will be recovered if production is by the pressure depletion method. It is the difference between the recovery by these two methods that determines the quantity of heavier hydrocarbons that will be lost to the producer. The magnitude of this loss then becomes the criterion governing the economic advisability of cycling the contents of the reservoir.

The range of properties covered by the presently known condensate reservoirs is tremendously wide and is increasing steadily. We refer here to the properties of pressure, temperature and content of condensible hydrocarbons. A little over a year ago we prepared a comparison of the phase characteristics of a range of reservoirs known to us at that time.[1] Fig. 1 is a reproduction of these data and shows a maximum retrograde range from less than one barrel per 1,000,000 cu ft to more than 100 bbl per 1,000,000 cu ft at reservoir temperature. These temperatures ranged from below 100 F to above 290 F. The reservoir pressure range of the examples shown is from 2800 psia to 5800 psia. Fourteen months have passed and the picture has changed a bit. Yesterday's rich, high pressure condensates have become mediocre and are well on the way to becoming tomorrow's lean, low pressure reservoirs. The temperatures are also going up in some places. For emphasis of this rapid trend in properties Fig. 2 was prepared. Fig. 2 is the same as Fig. 1 except that it is reduced in size in order to increase the range of the pressure and the liquid volume scales. The term "liquid volume" as used on the figure means barrels of liquid phase hydrocarbons at the temperature of the reservoir, and under the indicated pressure, per million cubic feet of separator gas. These curves serve to show the rates of condensation of the examples as the pressure is allowed to decline on a constant weight and composition of sample, as well as to fix the dew point of the mixture. To the reduced illustration has been added one of the richer of the recent condensates exhibiting a normal reservoir temperature of 190 F and pressure of 4600 psi. This sample proved to be undersaturated, the dew point occurring at a pressure almost 400 psi lower than the virgin reservoir pressure. To this figure has also been added the very scanty information so far secured on a "high" pressure sample, as contrasted with the "intermediate" pressure in the 4000 to 7000 psi range. The data are incomplete due to the unwillingness of the operator to push the windowed cell to pressures higher than 10,000 psi without first doing some intensive testing and possibly redesigning of the window for the already present 12,000+ psi reservoirs. As to temperature, one well has been reported to have a bottom hole temperature of 330 F.

The field gas:oil ratio has shown an interesting trend. Fig. 3 illustrates this characteristic. For several years there has existed a rather broad line of demarcation between the liquid phase, or oil reservoirs, and the gas phase, or condensate reservoirs. During this period Dr. Katz of the University of Michigan estimated that the line of demarcation would eventually fall in the region of 5000 cu ft per bbl. Combination reservoirs (oil reservoirs with a gas cap usually well separated

†Prepared from notes used in talk presented at recent Short Course program at Texas A & I, Kingsville, Texas.

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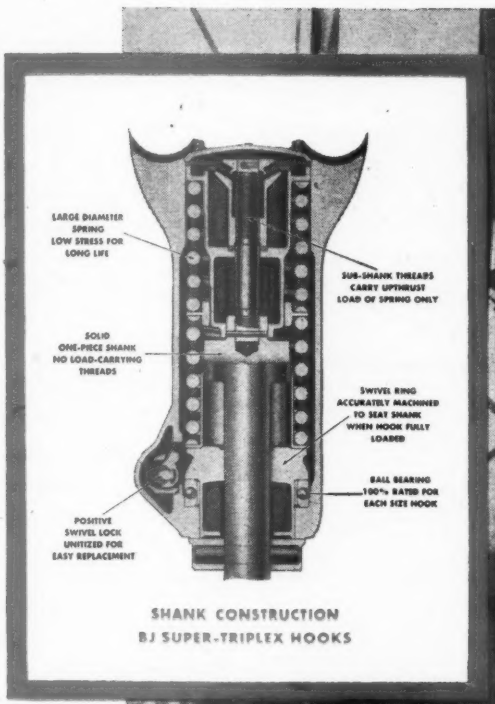
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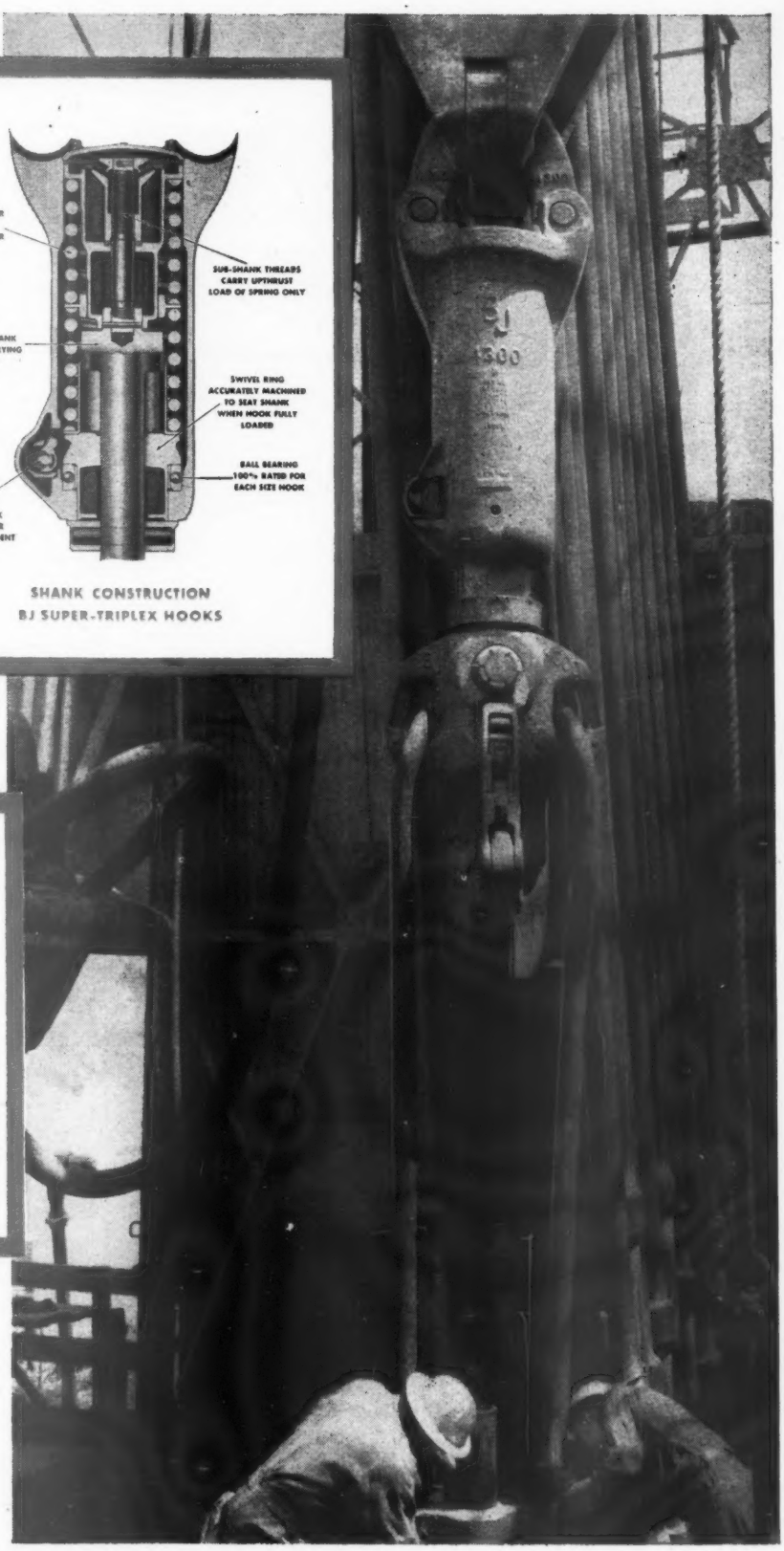
AMPLE CLEARANCE DESIGNED TO ACCOMMODATE HEAVIEST SWIVEL BAIL
HEAVY OVERHANGING SECTION TO TAKE POUNDING FROM SWIVEL BAIL
SADDLE TYPE LOWER LOCKING ARM ELIMINATES WEAR TO BODY SECTION



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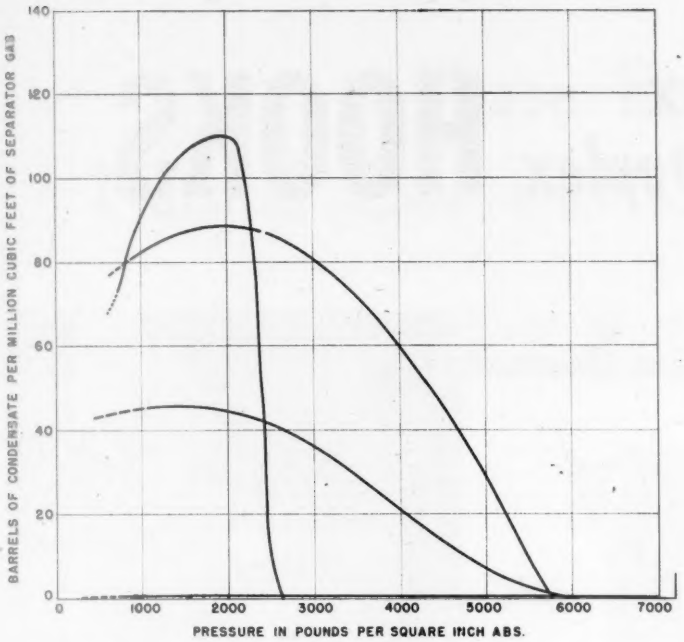


FIG. 1. Some examples of retrograde condensation.

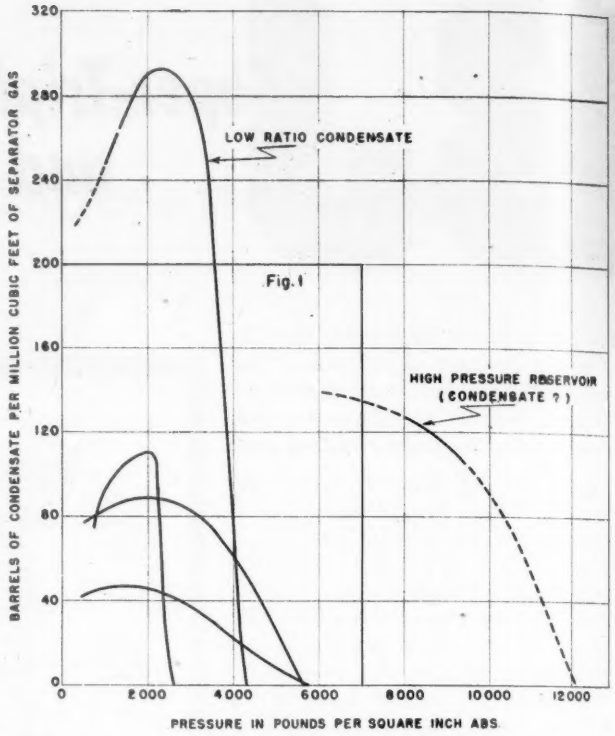


FIG. 2. Fig 1 with low ratio condensate curve and high pressure reservoir data added.

by gravity) have seemed to bridge over this unexplored region. But although they exhibited ratios from 600 cu ft to several thousand cubic feet of gas per barrel of oil, they could not be considered as containing gas in solution, but were producing both oil with its solution gas together with an accidental volume of fixed gas-cap gas. This apparent gap in the ratios of naturally occurring oil and gas accumulations has now been definitely closed and has actually been overlapped by more than 1800 cu ft per bbl. This is illustrated by a sample on the reservoir liquid side of the line with a separator gas:oil ratio of the order 4800 cu ft per bbl, as against one on the reservoir gas, or condensate, side of the line with a gas:oil ratio of just over 3000 cu ft per bbl. Neither of these two samples was under saturated at reservoir conditions; that is, the bubble point pressure of the liquid phase reservoir was below the virgin reservoir pressure and therefore the liquid could possibly have held more solution gas than was actually present, while the dew point pressure of the condensate reservoir was several hundred pounds lower than the virgin reservoir pressure, and the gas could have contained in the gas phase more liquid than was actually present.

To summarize these data briefly, we have at present these property ranges in presently known condensate reservoirs: Pressure from below 2000 psi to above 12,000 psi; temperature from below 100 F to 330 F; separator gas:liquid ratios from more than 500,000 cu ft of gas per bbl to less than 3100 cu ft; reservoir condensation rates (at maximum retrograde pressure) ranging from .4 bbl per 1,000,000 cu ft to 290+ bbl per 1,000,000 cu ft of gas. These comparisons are made to acquaint you with the wide variety of properties in presently known condensate reservoirs. And although the rate of advancement of the known pressure, temperature, and ratio trends may not continue at the indicated rate it is quite certain that the limit has not been reached.

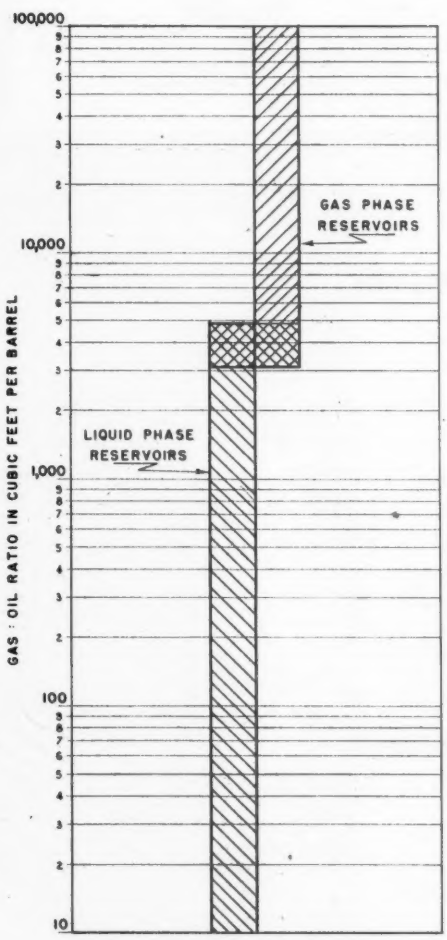


FIG. 3. Illustration of overlapping of gas:oil ratios of condensate and liquid phase reservoirs.

Before the properties of a reservoir can be determined it is necessary to secure a portion of the reservoir content which can be relied on to exhibit those properties in their proper magnitude. Too much emphasis cannot be placed on the importance of securing representative samples when these are to be used in reservoir equilibrium studies. Separator sampling is universally used for condensate reservoirs. This subject has been covered in a previous article[1] but will be briefly reviewed here. It is the writer's opinion that better sampling will be done by the field men if they understand exactly what is required of a sample and what is to be done with the sample after delivery to the laboratory. The ideal sample would consist of a portion of the undisturbed

STEVENS ZONE IN GOSFORD FIELD, KERN COUNTY, CALIFORNIA

Mud (Clay, Quebracho, Pyro):
R_m = 1.9 ohms at BHT
Bit size: 11"
Spacings: AM = 10"
AO = 10'
AO' = 19'

This is another in a series of interpreted electrical logs from identified formations and fields which Schlumberger will reproduce in this publication. If you would like to keep this entire series, please write to us on your letterhead and we will be glad to send you a reprint of this log (and preceding logs in this series) with a binder in which you may file subsequent logs as they are published. This series is made possible through the courtesy and cooperation of the oil operators who have released these logs.

8

LOG ANALYSIS

1) Water saturation S

R_o = 2 ohms at bottom of well.

The comparison of the different resistivity curves leads one to determine values for R_t respectively equal to 15 and 4 ohms in sections A and B.

In level A, $S = \sqrt{\frac{2}{15}} = 36\%$

In level B, $S = \sqrt{\frac{2}{4}} = 70\%$

2) Formation water resistivity R_w

With $SP = -70 \log_{10} \frac{R_m}{R_w} = -80$ mv.

(average of A and B Sands)

$R_w = \frac{1.9}{13.8} = 0.138$ ohm BHT, or 1400 G/G

3) Porosity p

$F = \frac{R_o}{R_w} = \frac{2}{.138} = 14.5$

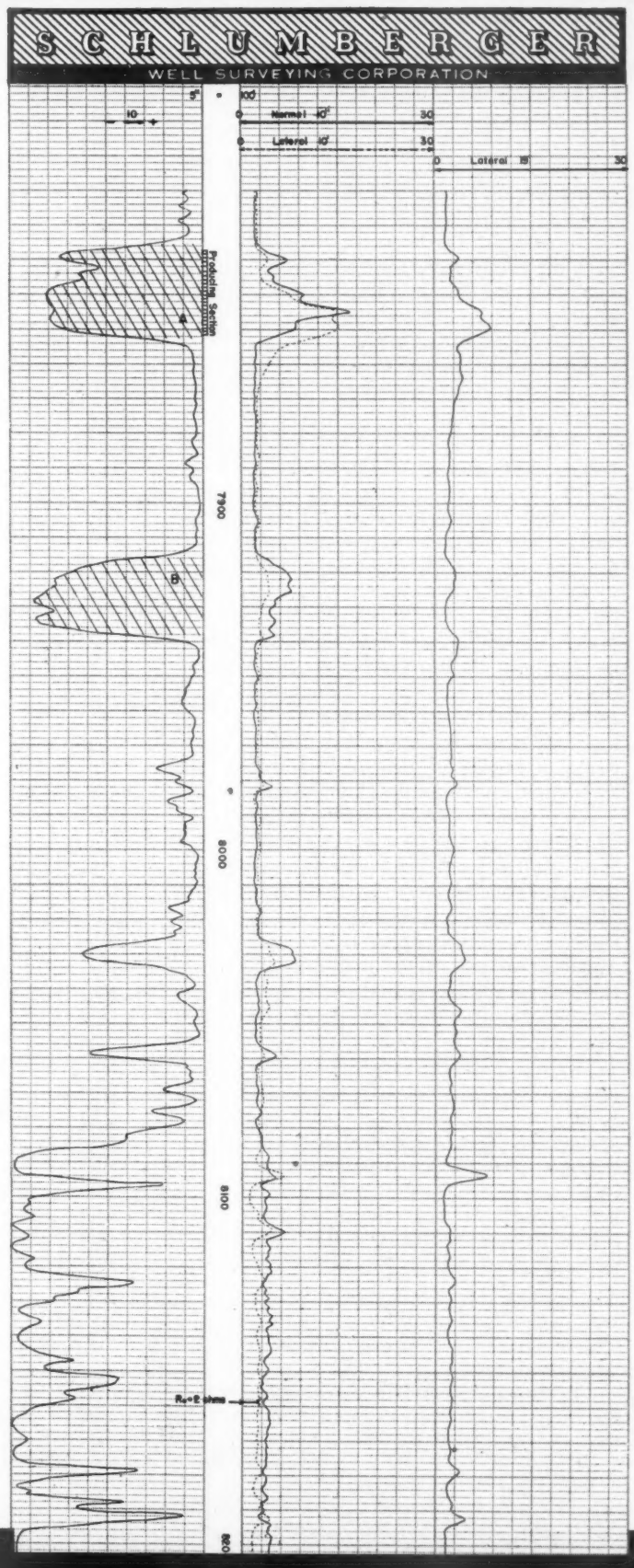
$p = \sqrt[m]{\frac{1}{F}} = 22\%$ $\quad m = 1.8$

CORE ANALYSIS

Porosity: 22%
Water Salinity: 1400 Grains per Gallon maximum

PRODUCTION RESULTS

Producing Section: 7829-7853
Production Potential: 154 bbl./day 34° API, 0.3% cut



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single phase fluid existing in a virgin reservoir. This portion would have to be secured and maintained in the single phase condition during withdrawal from the reservoir and subsequent storage until used. It should be single phase throughout the period of examination in order that sub-samples of the main sample may be taken from time to time for the various determinations made. These sub-samples must of necessity be exact duplicates of the original and hence of the reservoir, in order that the results from the various determinations might be comparable and consistent. This situation is approachable in the case of a high P. I. well in a single phase oil reservoir by the securing of subsurface samples when using reliable instruments and proper technique. This, however, is impossible in the condensate reservoir. The reason is twofold; first, the conventional subsurface sampler does not take a sufficiently large sample for analytical work of the condensate type. Second, and most important reason is that the sampler, in being withdrawn from the well, is unavoidably cooled by the trip to the surface. This cooling and the accompanying pressure drop both contribute to the condensation of a part of the sample to the liquid phase. This minute, but important quantity of liquid not only wets all of the inner surfaces of the sampler, but also finds its way into the intricate threaded joints, seals, tripping, and valve closing mechanisms of the instruments to a degree that makes it impossible to transfer the sample so secured into the analytical apparatus or storage containers without the loss of these important components to some degree.

As it is impossible to bring a condensate to the surface without condensation to the two phase condition, the obvious remedy is to separate these phases to as great a degree as possible by dropping the pressure below the maximum condensation pressure (750 to 1000 psi) thus producing the greatest possible condensation. Then, after separation of the gas and liquid, accurately meter the separate phases and secure representative samples of each. The gas and liquid thus separated can then be handled with relative ease and portions can be charged to the various pieces of apparatus for determination of their separate properties. The assumption is made that the well stream having previously been stabilized, is in its overall composition, producing a mixture which is equivalent to the original single phase gas existing in the reservoir.

The analysis is begun by determining the hydrocarbon composition of the separator samples. These analyses

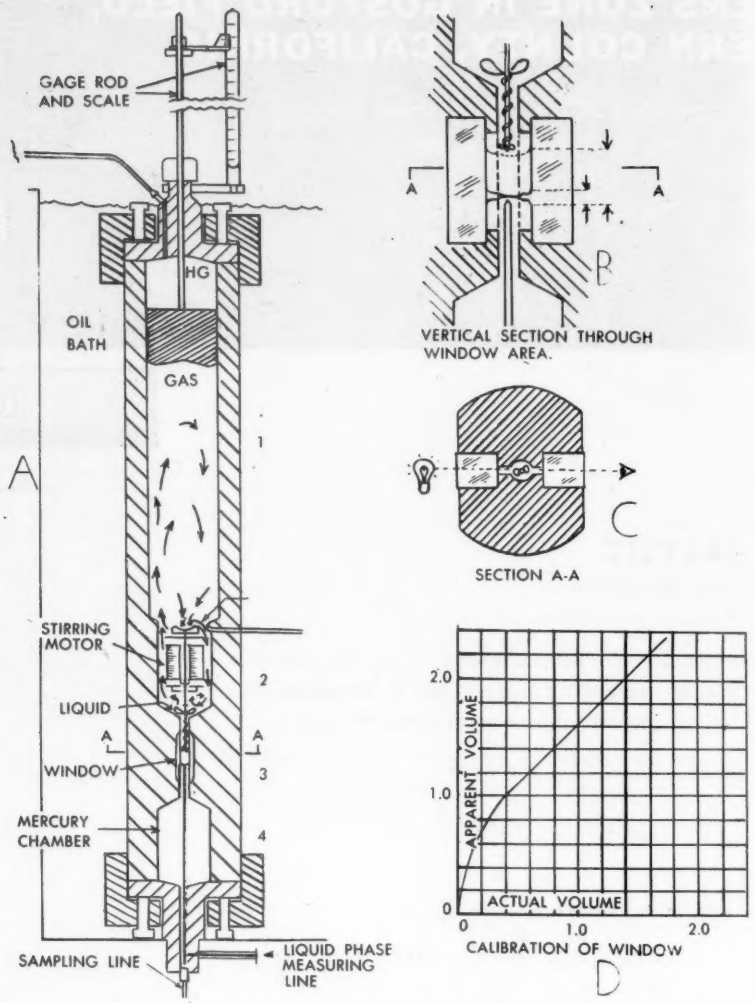
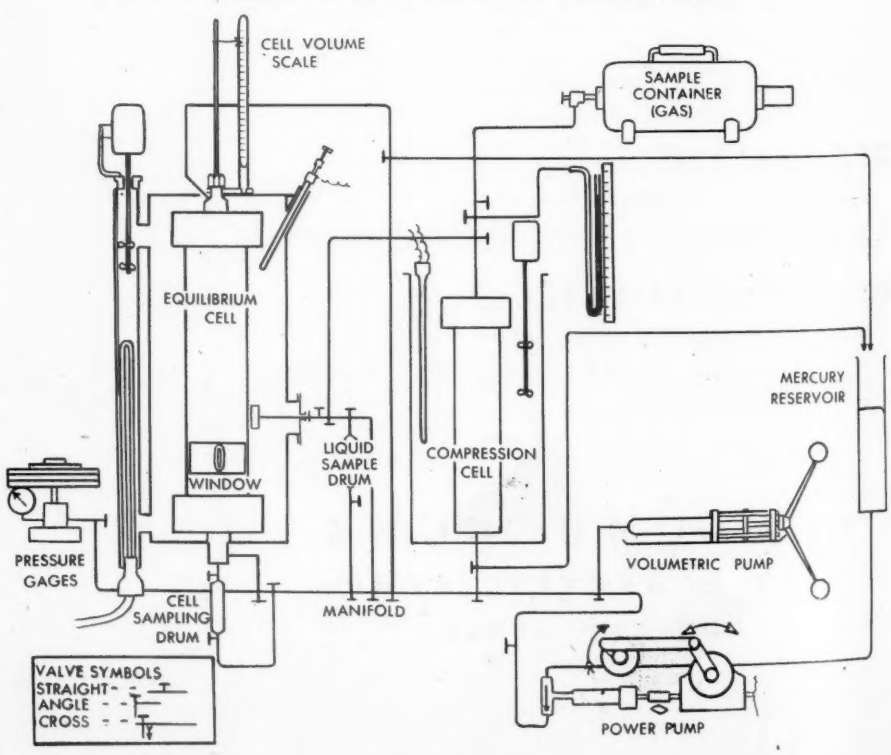
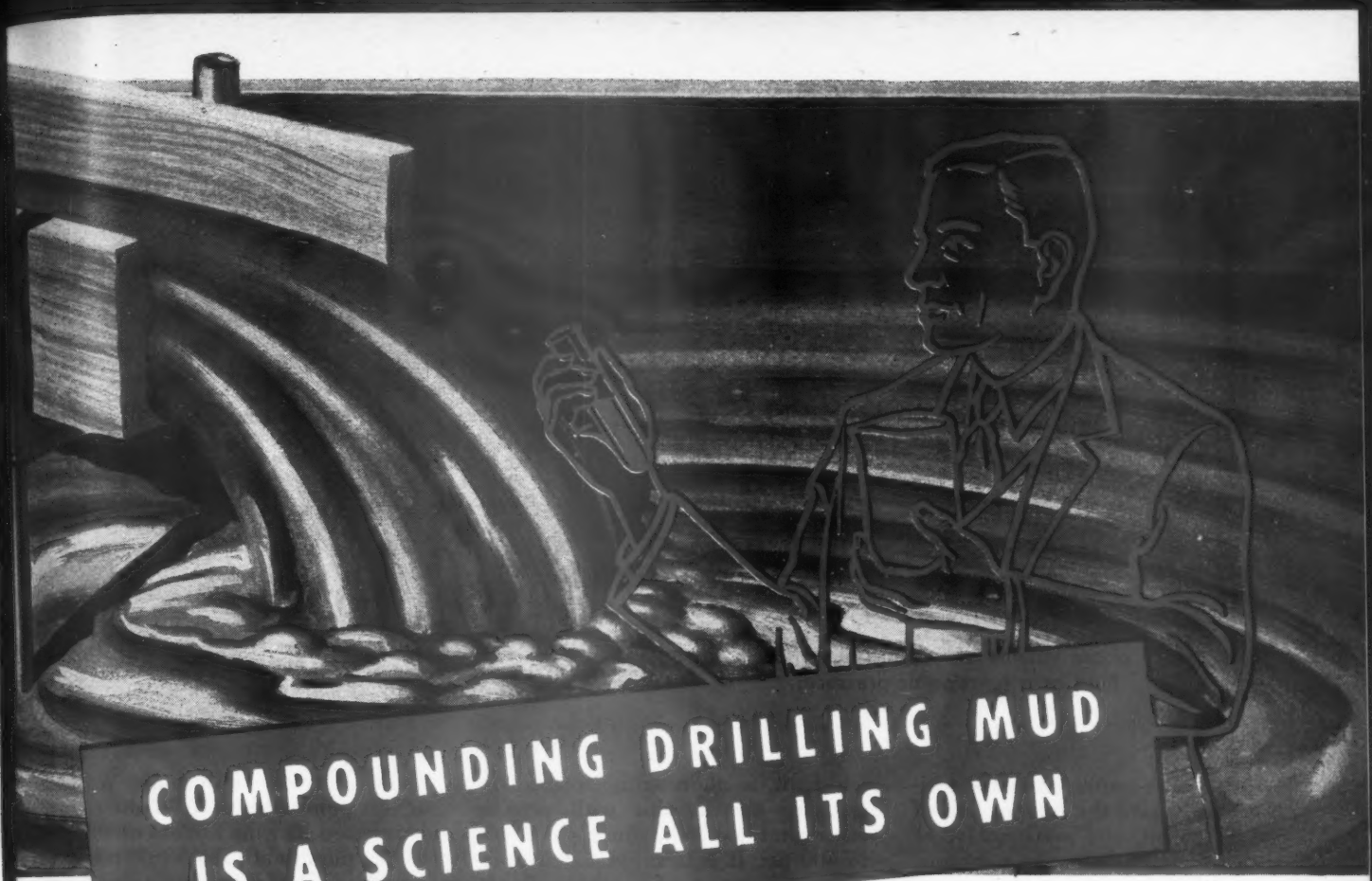


FIG. 4. Equilibrium cell in simplified section.

FIG. 5. Diagram of equilibrium cell and auxiliary equipment.





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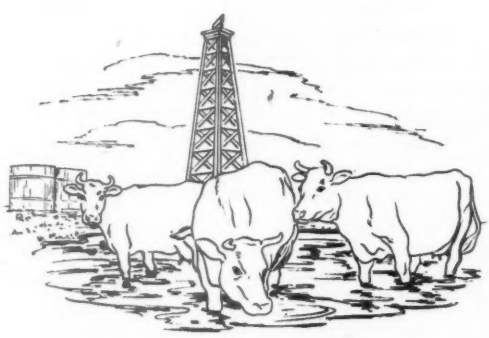

Through chemistry, modern drilling muds that throb through flow lines and play such a vital role in today's deep, high pressure oil wells have evolved into a complex, specialized science all their own.

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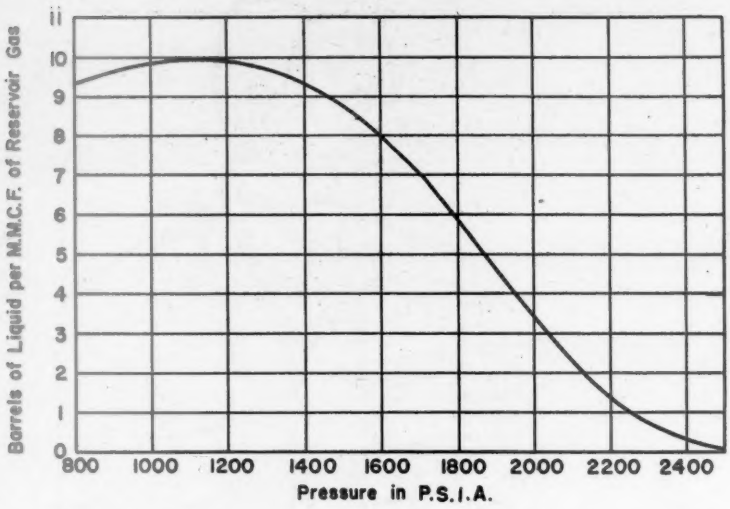


FIG. 6. Liquid phase volume of a constant weight of reservoir fluid as a function of pressure.

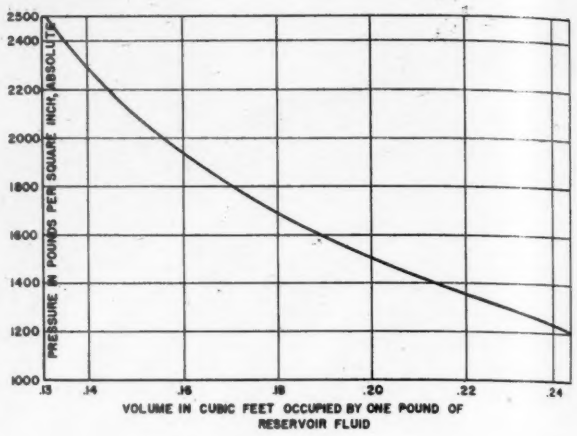


FIG. 7. Pressure-volume relationship of one pound of reservoir fluid.

may then be re-combined mathematically so as to give the composition of the well stream, and presumably, of the single phase gas in the reservoir. Portions of the separator gas and liquid are now charged to the equilibrium cell in the previously determined ratio of gas to liquid volume as produced through the separator. The resulting two phase mixture then has the composition of the well stream and of the reservoir to within the limits of error in the measuring, sampling and handling. From the composition and known quantity of separator gas and liquid used in charging the cell the weight of the sample charge is easily calculated. The equilibrium cell used in these studies is shown in simplified section in Fig. 4.

The body of this cell is bored from a solid bar on three diameters and has four chambers. In Detail A of Fig. 4 the upper chamber (1) holds the floating piston that is the means used in varying the volume; immediately below is the motor chamber (2) of slightly smaller diameter in which is housed the mixing motor, followed by the observation chamber (3) (see Detail B & C) which is ½ in. in diameter with windows on opposite sides in which the liquid volumes are measured; and finally a lower chamber (4) into which volumes of liquid phase material in excess of the capacity of the window section (3) may be drawn in order to bring the gas-liquid interface into view in the observation window. Fig. 5 is a diagram of the cell and its essential auxiliary equipment.

The normal procedure in the study of a well production mixture is as follows: The equilibrium cell is extended to its maximum capacity of approximately 4000 cc by forcing the piston to the top with compressed gas, after which it is thoroughly washed by spraying the interior with petrolic ether saturated with natural gas at 300 to 400 psi. It is then evacuated to remove all traces of washing fluids. Separator gas is charged to the cell to a pressure of from 700 to 1200 psi, and after ample time for temperature equalization the temperature is determined and the exact pressure is measured to one pound on the dead weight gage, and the volume under these conditions is observed. The volume of the charged gas at standard conditions is computed from these data and the deviation factor, which is determined for the gas at the charging temperature and pressure in another cell of fixed volume, or which may be calculated from the composition, using the psuedo-critical properties.

From this volume of gas and the separator gas:oil ratio the correct quantity of separator liquid is calculated, and after proper correction for differences in temperature and pressure this volume is injected into the cell. The volume of re-combined sample used varies from 6.0 to 10.0 cu ft at atmospheric conditions. The temperature of the oil bath is increased to reservoir temperature and maintained throughout the duration of the run. The stirring motor inside the cell is started. At the end of 48 hours a reading is taken in which the following data are recorded: Temperature of the oil bath, absolute pressure of the cell, total volume of the cell, and the apparent volume of the liquid phase. The volume of liquid phase residue in the cell is measured by lowering the gas:liquid interface until it is below a zero mark about midway of the cell window, then by means of the volumetric pump, forcing the interface up until it coincides with the zero mark. The volumetric pump reading at this point is recorded and mercury is injected into the bottom of the cell by the pump until the liquid-mercury interface coincides with the zero index and the pump reading is again recorded. The difference in these two readings is a measure of the displacement volume of the liquid. Due to the capillary depression of the contact of the mercury with the inner surface of the glass window, and the capillary elevation of the liquid against this same surface, (Detail B of Fig. 4), however, the apparent position of these points of contact is farther apart than the actual volume of liquid involved.

The correction factor in this case amounts to —.6 cc, for all apparent volumes in excess of 1.0 cc; that is, for a 1 cc volume difference, as determined above, the actual calibrated volume is .4 cc, (see Detail D of Fig. 4) which is sufficient liquid to just cover the surface of the mercury in the window section. For volumes of less than .4 cc (actual) the ratio of the apparent volume to the actual volume becomes progressively larger.

For instance, an apparent volume of .44 cc corresponds to an actual volume of .10 cc, and an apparent volume of .1 cc corresponds to an actual volume of .02 cc, and an apparent volume of .02 cc is equivalent to an actual volume of .003 cc. Volumes of this last order, and until they completely disappear, are recorded as a "trace," and when there is no longer any sign of a wet surface against the window, are reported as "dry." This magnification of minute traces of liquid is very fortunate as it provides an increasingly accurate measurement of the residual liquid volumes as these volumes become smaller, thus maintain-

ing the degree of accuracy and actually increasing it as the dew point is approached.

The total volume of the sample is determined by means of a gage rod attached to the top of the piston, extending through a packing gland in the top closure of the cell, and carrying a vernier on its upper end which indicates the cell volume on a scale. This scale is calibrated in 10 cc units and the vernier subdivides these into 1 cc units.

Following these observations the pressure is boosted 300 to 800 psi, depending on the final pressure to be attained, by pumping mercury into the top of the cell above the floating piston, thus forcing the piston down and compressing the mixture, and at the end of 24 hours another reading of the above mentioned factors is made. The process is repeated in appropriate pressure increments until the liquid phase disappears at or before the reservoir pressure is reached, or until it becomes apparent that there is going to be a persistent liquid phase residue at pressures substantially higher than reservoir.

These observations furnish the basis for two sets of data. The figures giving the apparent volume in cc of residual liquid, after being corrected to actual volume, are converted to equivalent barrels of liquid at reservoir temperature and observed pressure per 1,000,000 cu ft (MMCF) of either separator gas or of single phase reservoir gas volume corrected to its theoretical volume at 60 and any desired pressure base. An example of this type of information is given in Fig. 6 in which barrels of liquid per MMCF of reservoir gas are plotted as a function of pressure at reservoir temperature. After the computation of the weight of the total sample charged to the cell the figures indicating the volume of the total sample are the basis for the calculation of the pressure-volume relationship of one pound of reservoir fluid, regardless of the physical state. Fig. 7 is an example of this data.

After reaching reservoir pressure the cell and the sample are treated as a model reservoir and with the temperature and volume held constant, a pressure depletion test is made in the following manner: Gas phase hydrocarbons are withdrawn from the cell through a suitable tap at a very slow rate until the pressure in the cell has been lowered 300 to 600 psi below reservoir pressure. After allowing several hours for drainage of the retrograde condensate precipitated by the pressure drop (during which time the pressure is held constant,) an observation is made through the window of the volume of the precipitated liquid.

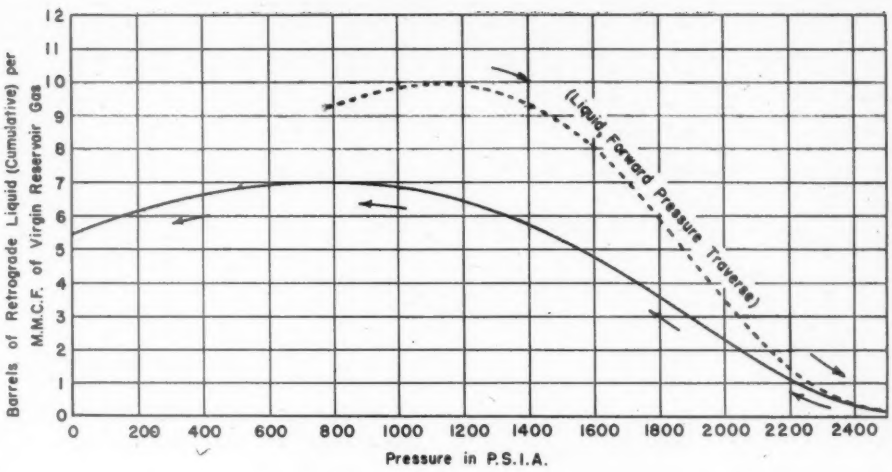

Barrels of Retrograde Liquid (Cumulative) per M.M.C.F. of Virgin Reservoir Gas
(Liquid, Forward Pressure Traverse)
Pressure in P.S.I.A.

FIG. 8. Residual liquid from pressure depletion of cell.

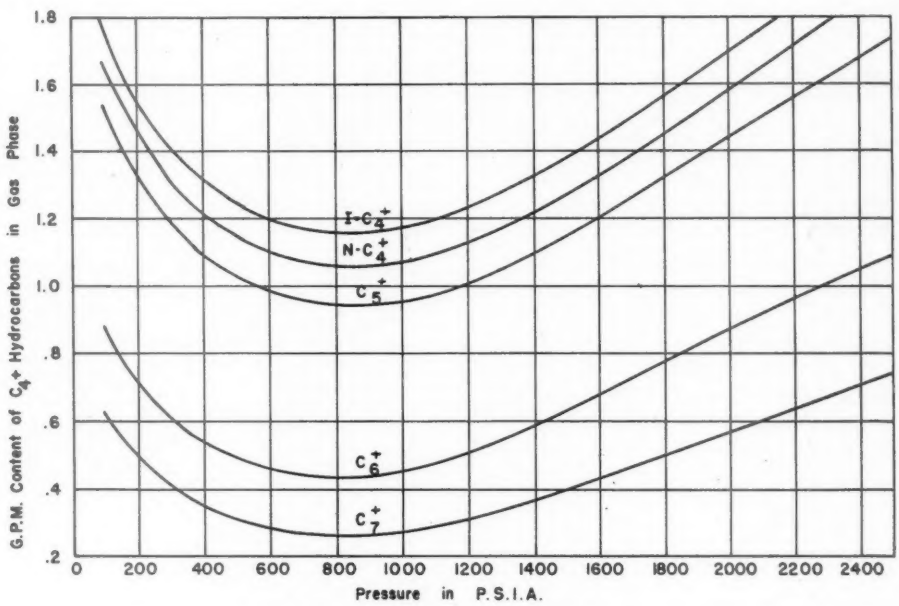


FIG. 9. Gasoline content of produced gas as a function of pressure.

This liquid volume is not to be confused with that described under Fig. 6, but is the accumulating liquid that is being precipitated from the *remaining* gas phase at any given pressure, while that in Fig. 6 represents the condensation from a *constant weight* of reservoir fluid. Following the condensate volume determination at this pressure a sample is taken at full cell pressure by mercury displacement of the gas phase hydrocarbons for analysis. Since the taking of the sample itself causes a further drop in pressure, the initial and final pressure during the sampling are averaged, and the analysis of this sample is recorded as the composition of the cell gas phase at this average pressure. The pressure is thus lowered in steps from reservoir to approximately atmospheric, with from four to eight samples being taken along the way for hydrocarbon analysis. These analyses will be discussed later.

The cumulative volumes in cc of retrograde condensate precipitated by this process are converted to equivalent barrels of liquid at reservoir temperature and existing pressure per MMCF of virgin single phase reservoir gas, and are then plotted as a function of pressure in Fig. 8. For comparison, the liquid phase curve, as in Fig. 6, is superimposed on this graph.

From the calculated composition of the single phase reservoir gas and the analyses of the gas samples taken during the pressure depletion run, the G.P.M. content of each of the gasoline hydrocarbons from iso-butane through

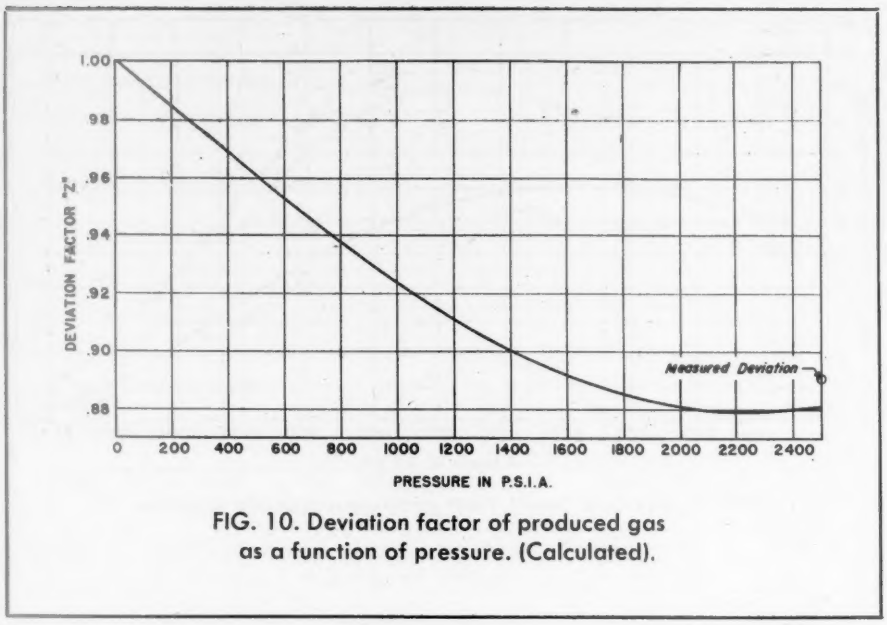


FIG. 10. Deviation factor of produced gas as a function of pressure. (Calculated).

heptanes plus for each of the average pressure points may now be calculated. Fig. 9 is a graph in which these gallons per thousand cubic feet (GPM) values for the various pressures are plotted in the form of a series of curves, beginning with the C_7+ content of the produced gas at the bottom and adding successively the content of C_6, C_5, N-C_4, and I-C_4.

By the use of pseudo critical data the deviation factor for the gas phase at each of the sampling pressures may be calculated from the analyses. These deviation factors, when plotted as a function of pressure, give a curve similar to Fig. 10.

Fig. 11 shows the variation of the percentage occurrence of each of the gas phase hydocrabons in the residual gas as the pressure of that gas is allowed to decline. This graph is drawn on semi-log paper for the purpose of magnifying the variation of those components which occur in small quantities.

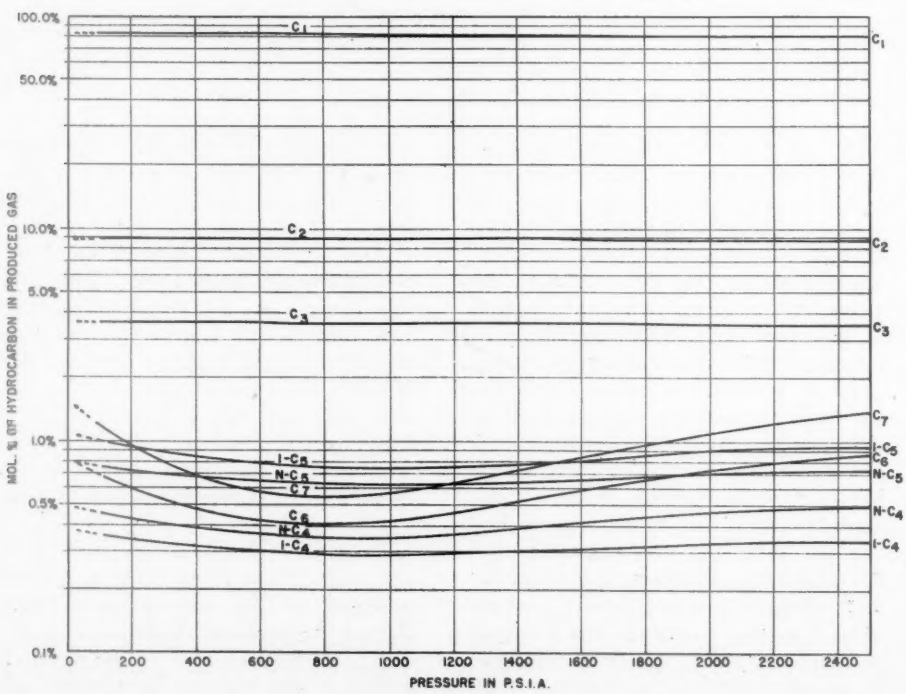
Discussion of the Results

The data resulting in Figs. 6 and 7 furnish a quick means of determining the condensation and volumetric behavior of a given hydrocarbon mixture. These values are the most accurate in the determination for the reason that the weight of the charge is fixed, and in running the pressure traverse in the direction of increasing pressures assurance is obtained that there is no error in the liquid volume measurement due to wet cell walls. The use of a 48-hour stirring period on the first (low pressure) equilibrium observaton has been adopted because of the reluctance of the two phase mixture to come to equilibrium. It is timely to observe here that the attainment of the two phase system from the single phase by pressure drop occurs instantly, while the reversal of the process by pressure increase is, by comparison, infinitely slow. Experimentation has proved that it takes from 14 to 20 hours to achieve the equilibrium change resulting from a pressure increase of from 400 to 500 psi. However, after 20 hours under the conditions of contact as produced in this cell the liquid phase volume becomes constant indicating that equilibrium is established. If, on the other hand, the pressure is dropped an equivalent amount, the time that the change becomes apparent in the window is a matter of a few seconds, and the time required to become stable is limited by the time required for the precipitated liquid to drain into the small diameter visible section of the cell.

In the event that there is any considerable volume of liquid phase hydrocarbons remaining when the sample reaches reservoir pressure, only one conclusion may be drawn and that is that the well production mixture at the time of sampling was two phase in the reservoir. This discovery in itself is valuable to the well owner and merits additional attention.

The usual result of a condensate study of this kind is a dew point pressure somewhere in the neighborhood of the reservoir pressure. The importance to be attached to the exact dew point in this case is determined to a considerable degree by the angle at which the curve approaches the dew point. Fig. 12 illustrates some typical curves of condensates as they approach their reservoir pessures. The curve on the left illustrates an unsaturated reservoir and approaches the dew point line at a steep angle and at a pressure considerably below reservoir pressure. This particular dew point was made to appear from the single phase gas with a pressure drop of less than 10 psi. The middle curve illustrates the normal approach of a saturated condensate line to the dew point, and is seen to strike the dew

FIG. 11. Variation in the analysis of the produced gas as the pressure declines.



point line at a very flat angle. The pressure range required to cause this type of mixture to change from the single to an incipient two phase system is greater than that of the unsaturated reservoir and is more readily determined graphically by taking several observations near this point. The curve on the right illustrates the type of mixture which is apparently contaminated by a minute quantity of extra heavy molecular weight hydrocarbons, either picked up mechanically from the crude oil in the reservoir, or the result of a deposition around the well bore of a quantity of heavy ends from the reservoir gas resulting from heavy production of the well previous to sampling. In any event, too much importance should not be attached to the actual dew point pressure in this case. Some examples of this type of approach may show a liquid phase volume of as low as 10 gallons of liquid per MMCF of reservoir gas at reservoir pressure, but with a substantial portion of this persisting at several hundred pounds higher pressure. And it should be remembered that in the case of a high pressure reservoir a substantial portion of this liquid may be due to dissolved methane, ethane and propane.

The pressure-volume data (Fig. 7) is useful in the estimation of the reserves remaining in the reservoir under a declining pressure should the field be produced without cycling.

The pressure depletion run is intended to simulate the behavior of a reservoir that is produced without cycling. All of the figures obtained in this part of the analysis are subject to error from two sources, both of which tend to make all of the observed liquid volume values lean. For this reason, in the drawing of all the curves derived from this source, the higher values are deliberately favored, rather than striving to draw them on the average. The first source of error is the mechanical carryout of cell liquid phase hydrocarbons that are still floating in the gas as a fog. This loss does not appear to be a serious factor in the rich samples when the liquid particle rapidly becomes heavy enough to settle by gravity, or to be mechanically thrown out by the centrifugal action of the stirring motor. On the other hand a lean sample seems to produce a very fine fog that settles out slowly and unless watched closely, will pass on out with the gas, resulting in a low retrograde condensate curve. Under certain conditions, this curve may be deficient, and at the same time the hydrocarbon analysis also be low in C_6 and C_7+ fractions, resulting in an actual deficit between the vapor

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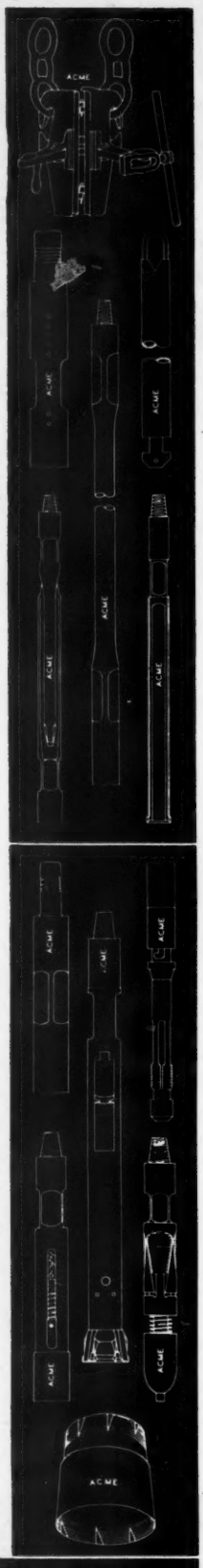

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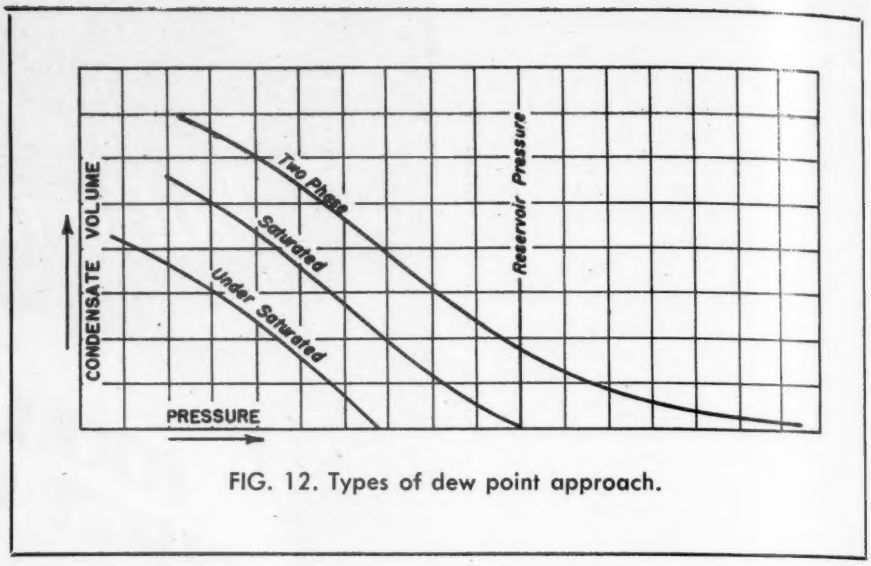

FIG. 12. Types of dew point approach.

phase hydrocarbons shown to be withdrawn from the cell and the liquid and gas phase hydrocarbons remaining in the cell. Some evidence is being accumulated that some reservoirs may be subject to the persistent fog remaining in the reservoir pores and being produced with the equilibrium gas.

The second possible source of error is due to the unavoidable wetting of the inner surfaces of the cell during the draw down period. Polishing of the inner walls and the arranging, insofar as possible, for the efficient draining of all projections in the cell, such as motor, insulated terminal, etc., tends to minimize the liquid holdup. In one actual test it was determined that an expansion of the cell volume by raising the piston gave a result that was within the accuracy of the liquid phase measurement but it required a period of about 5 hours for the drainage to take place. Thus it may be seen that with all possible precautions taken to provide efficient draining of the inner surfaces of the cell, the time element, both in the actual pressure depletion operation and in the drainage period allowed, is of major importance. It is also well to keep in mind that the results secured in this procedure represent minimum values in all cases except those of the persistent fog (or supersaturated gas) as mentioned above.

The GPM values as expressed in Fig. 9, being derived from the hydrocarbon analyses of the withdrawn gas phase material, are subject to the same limitations as are the analyses themselves.

A third possible source of error stems from the difficulty of transferring high pressure samples that change from a single phase gas to a two phase mixture due to the drop in temperature, from the sample container to the low temperature fractionator. This problem has been largely overcome by taking the last traces of heavy hydrocarbons from the container under high vacuum while the container is maintained at approximately the temperature of boiling water, and finally displacing with hot mercury.

Although this would appear to be a formidable array of difficulties and is in no sense to be passed over lightly, in at least one case in which a check has been made the sum of the C_4+ components that were produced as gas phase and the C_4+ components remaining in the cell as both gas and liquid phase hydrocarbons came to within approximately .3 per cent of the total C_4+ hydrocarbons in the separator gas and liquid samples charged to the cell. The accuracy of the calculated deviation factors may be judged by the actual deviation factor of the re-combined sample at or above the dew point pressure, this being the only region at which the measured deviation is available without destroying the sample for further study. This measured factor is placed on the graph of calculated deviation factors (Fig. 10) for comparison. These determined factors are usually within .03 of the calculated figures and frequently fall within .015.

Acknowledgment

The author wishes to express his gratitude to the Management of Gulf Oil Corporation and to Mr. Walter F. Rogers, Chief Chemist, for permission to prepare and present this discussion, and to The Houston Laboratories of Houston, Texas, owners and operators of the apparatus described herein.

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1. "Laboratory Studies and Their Relation to Cycling Problems," J. P. Sloan, *Oil and Gas Journal*, November 25, 1948.

* * *

News

Drilling Increases In State of Kuwait

The biggest single concentration of diesel drilling power outside the continental U. S. is now established in one of the littoral states of the Persian Gulf—a desert area of some 6000 square miles at the northwest corner of the Persian Gulf, which forms the state of Kuwait.

Although the National Supply Company has placed numerous of its Type 50 and Type 100 rigs in the Middle East fields, the present rig, Type 125 Consolidated, is the largest shipped by the manufacturer to this area so far. Word from the Burgan field, where the rig is set up, is that it will be used for deep test drilling past the 5000-ft average that is already capable of tens of thousands of barrels daily production.

Test drilling at Kuwait was commenced in May, 1936 but the first well proved unsuccessful. A second test well was spudded in on October 16, 1937 and oil was struck for the first time in February of the following year. Previously, the entire Kuwait desert had been undisturbed. The port town of Kuwait was once suggested as a terminus for the pre-World War concept of the Berlin-to-Baghdad railway, and the chief industry, until oil was discovered, was boat building and coastal trading.

The present Burgan field consists of about 60 wells spaced a mile apart. A National Supply representative noted that the entire rig-building project has assumed the aspects of a minor "Marshall Plan" — in that Bedouin tribesmen in the area shower themselves with the rig water hose, and manage some astonishing salvage operations from the crate parts in which the 125 rig was shipped. Much of the drilling operations will be conducted in temperatures of 130 F-plus.

Venezuelan Production Up

Colon Development Company, Ltd. produced 440,040 bbl of oil in Venezuela during the five weeks ending January 2. This compared with the 335,587 bbl produced by this company during the four weeks ending November 28, 1949.

Production Rate Increases

Production of oil in Louisiana during 1949 rose to 196,414,830 bbl, according to figures released by the state Department of Conservation. Production in 1948 was about 187,000,000 bbl. There were about 293 rigs drilling in the state at the end of 1949.

World Oil Assessed

A new geography of world petroleum has just been completed by a group of petroleum geologists under the sponsorship of the American Geographical Society. The comprehensive volume, titled "World Geography of Petroleum," will be published in early 1950 by Princeton University Press. Because of the importance of oil in commerce, industry, and political and military strategy, the new oil geography will be important in shaping policies in these fields. The work was prepared under the editorship of the well-known geologist Wallace Pratt, with the assistance of Miss Dorothy Good of the American Geographical Society, and will contain much new material, including 50 specially prepared maps and numerous tables and diagrams.

General Petroleum Awarded

The General Petroleum Corporation has received two awards from the National Safety Council for improving its safety record in the drilling and producing operations of the company over previously established records. The safety awards commended General Petroleum's production department for having achieved a safety record 20 per cent better than the national average for the year ending June 30, 1949 as part of its 1948-49 Safety Contest.

Form Permian Basin Society

The Society of Exploration Geophysicists, headquarters in Tulsa, Oklahoma, received a petition for affiliation with the national organization from the Permian Basin Geophysical Society of Midland, Texas. Approval of the petition would establish the Permian Basin section as the seventh local group of geophysicists to become a part of the SEG. Other sections are now situated in Tulsa, Dallas, Houston, Texas, Shreveport, Louisiana, Fort Worth, and Los Angeles, California. Groups are also being organized in Calgary, Alberta, Canada, Denver, and San Antonio.

Officers of the new society in Midland are: Lorenz Shock, district supervisor for National Geophysical Company, president; Win Payne, geophysicist for Pure Oil Company, vice president; W. L. Homan, seismologist for Republic Exploration Company, secretary; and E. L. Mount, seismic supervisor for Continental Oil, treasurer.

The Permian Basin section of the SEG will include geophysicists working in West Texas and the southwest part of New Mexico. This territory embraces the Scurry County "reef" area, purported to be among the richest oil-bearing areas in the world. The Permian Basin section was formed through popular demand of the many geophysical field crews exploring the area, to advance the science of geophysics and to promote fellowship and cooperation among geophysicists and geologists. More than 200 exploration scientists attended the first meeting.

Final announcement concerning affiliation of the Permian Basin Geophysical Society as a local section will be announced at the annual meeting of the Society April 24-27 in Chicago, Illinois.

Saudi Arabian Production

Crude oil production in Saudi Arabia during December amounted to 14,333,242 bbl, or an average of 462,363 bbl per calendar day, it was announced by the Arabian American Oil Company. Crude oil production for the year 1949 amounted to 174,008,629 bbl, an average of 476,736 bbl per calendar day. Crude run in the refinery for the same period was 46,269,619 bbl, an average of 126,766 bbl per calendar day.

Publishes 1950 Catalog

Descriptions of approximately 70 geology field courses to be offered during the summer of 1950 will be published by the American Geological Institute, 2101 Constitution Avenue, Washington, D. C., late in February. Each field course will be described from the standpoint of geographic location, geology of the area to be studied, methods of instruction and work during the course, required prerequisites, field facilities, cost, academic credit and details of registration.

Rotary rigs operating in oilfields of the United States and Canada.*

January, Weeks	Total	Gulf Coast	Pacific Coast	Oklahoma, Kansas	Arkansas, Louisiana, Texas	Illinois	Rocky Mountain Canada	New Mexico West Texas
1st	2112	496	126	364	153	108	157	708
2nd	2069	501	132	348	137	95	152	704
3rd	2029	515	128	341	140	41	142	709
4th	2019	502	136	332	141	59	142	707
5th	1958	469	132	330	136	61	142	688

*Figures released by American Association of Oilwell Drilling Contractors, as reported to them from Hughes Tool Company.

News

Drilling Firm Moves To Tyler

Headquarters for Delta Gulf Drilling Company, newly-organized company, will be moved to Tyler from Dallas. Chris Zeppa, Tyler, vice president, said the company will have its headquarters in the Citizens National Bank Building with Delta Drilling Company.

Zeppa stated that some personnel from the Dallas and Houston offices will be transferred to Tyler, and about 12 new personnel will be employed. The company will operate 14 rigs out of the Houston office and 7 from Odessa.

Society Publishes Directory

A directory of the Oklahoma City Geological Society is now available to members, with listings by individuals and companies. Also included are the names of past officers from 1921.

Los Angeles Nomads Chapters Hold Annual Business Meet

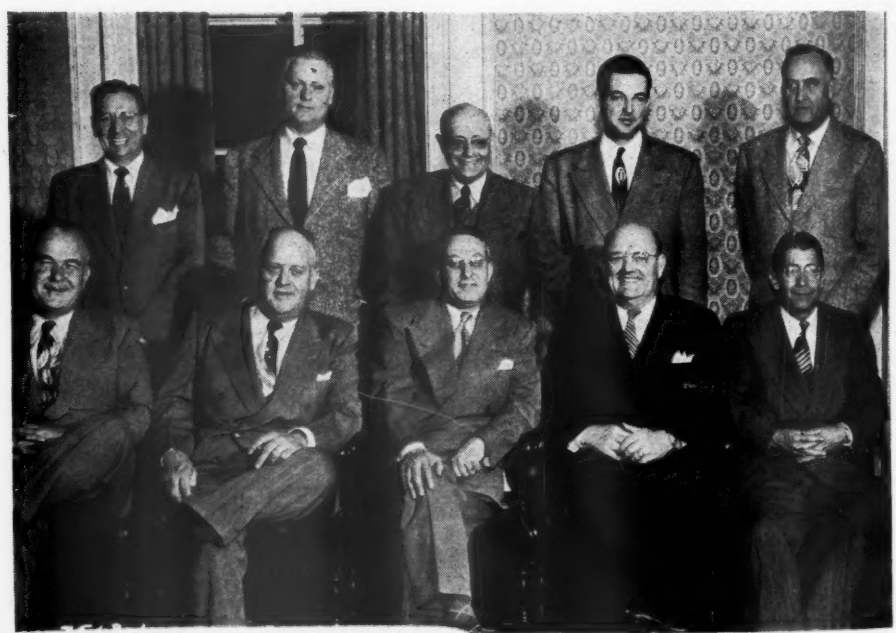
The annual business meeting of the Los Angeles chapter of Nomads was held last month in the Marine Room of the Jonathan Club. Inasmuch as this was a closed meeting, no outside guests were present. Principal item of business at the meeting was the counting of ballots and formal announcement of the results of the recent election of 1950 officers. New officers elected to office are as follows:

Earle Boggess, Baker Oil Tools, Inc., president; Ted Forsyth, Emsco Derrick and Equipment, vice president; Jack Ballagh, Extruders, Inc., secretary; Knight Templeton, Champion-Smith, Export Representative, treasurer; Jerry Engstrand, Grant Oil Tools, sergeant-at-arms; Herm Pachall, H. C. Smith Oil Tools, assistant secretary; John Flanagan, M. O. Johnston Oil Field Service, assistant treasurer; and James Hughes, Lane-Wells Company, deputy sergeant-at-arms.

Fred Ripley, International Derrick and Equipment Company and Lee Laird, Gil-Lair Products, Inc., were elected to the Board of Regents.

Present at the meeting was a regular member of the New York chapter of Nomads, Norman E. Yett, of Continental Supply Company, Caracas, Venezuela. In a brief talk, Yett presented a cross section of the activity in various oil producing countries of South America and what might be expected during the year of 1950. In Venezuela, he reported, purchases of equipment can be expected to remain about normal during the first half of the year, with no anticipated increase or cut-back in drilling and production programs. Wildcatting in the country probably will increase as more territory is opened to exploration.

Yett expressed the belief that unsettled conditions and cut-backs in Colombia, Ecuador, and Peru probably will slow drilling activity in those countries. Trinidad, he said, may experience a decrease in business as a result of the devaluation of the pound.



New officers of the Los Angeles Chapter of Nomads for 1950 are: Seated: Fred Ripley, International Derrick and Equipment, regent; Herm Pachall, H. C. Smith Oil Tools, assistant secretary; Earle Boggess, Baker Oil Tools, Inc., president; Ted Forsyth, Emsco, vice president; Knight Templeton, Champion-Smith, treasurer. Standing: Lee Laird, Gil-Lair Products, regent; James Hughes, Lane-Wells, deputy sergeant-at-arms; Jack Ballagh, Extruders, Inc., secretary; John Flanagan, M. O. Johnston Oil Field Service, assistant treasurer; and Jerry Engstrand, Grant Oil Tools, sergeant-at-arms.

Outgoing 1949 officers of Los Angeles Chapter of Nomads, including guest speaker for evening, are as follows: Seated: George Flanders; Earle Boggess; Lee Laird; Ted Forsyth; Fred Ripley. Standing: Norman E. Yett, Continental Supply, Caracas, Venezuela, guest speaker, Earl Rees, Knight Templeton, John W. Rife, and Jerry Engstrand.

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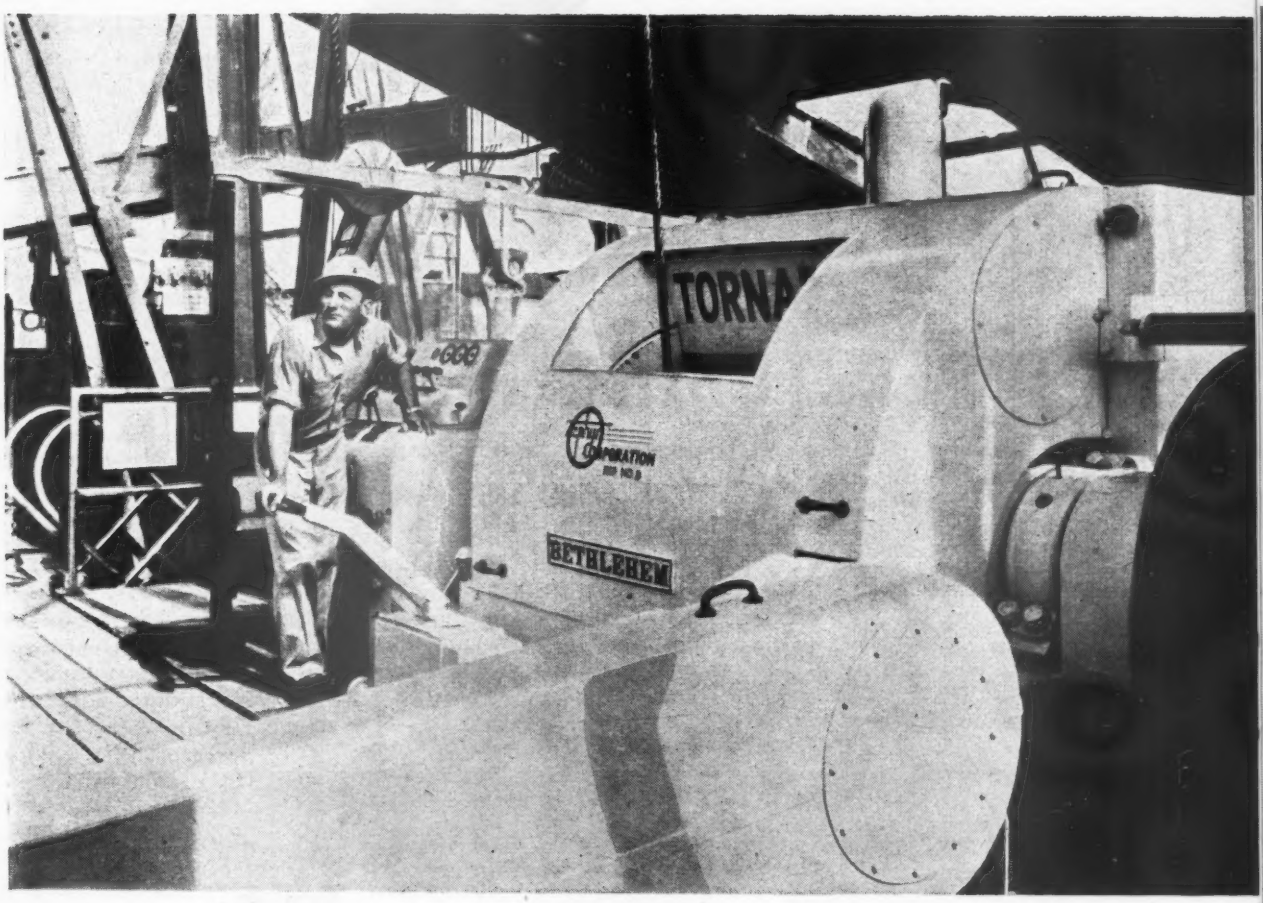

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Geological Society Announces New Books

The Southeastern Geological Society announces four publications, which may be obtained by writing the Society at P. O. Box 841, Tallahassee, Florida. Three field trip guide books —"The Tertiary Formations of Alabama," "The Tertiary Formations of the Ocala Uplift Area-West Central Florida," and "Cretaceous Deposits of East Central Alabama" are available at $3 each. A fourth book, "Mesozoic Cross-Sections of Florida, Alabama, and South Georgia," containing blueprints, electric logs, etc., may be obtained for $8.

Turbodrill Performs Below 5000 Ft

A recent test run of the turbodrill* in a 13,500-ft wildcat well near Creole, Cameron Parish, Louisiana, consisted of drilling with a 12¼-in. rock bit below 5000 ft. It made 347 ft of hole between 5045 and 5392 ft on the test run, which lasted about 7 hr and 30 min. Unlike the procedure in previous tests, the drill pipe was not turned continuously by the rotary table. It was turned occasionally, however, to be sure the pipe was free.

*Manufactured by Engineering Development Company of Dallas, Texas. It is powered by a multi-stage turbine driven by the drilling fluid.

The present model of the tool is 10¼-in. OD and 30-ft long. The bit and subs used make it about 37 ft in overall length. About 600 gpm of drilling mud was circulated in the test at Creole. The tool began to make hole at 5045 ft where the floor gage pressure on the mud line reached about 1250 psi. The pressure was about 1275 psi just before the tool was pulled from 5392 ft at the end of the test run. About 2500 ft of 13⅜-in. surface casing had been set and cemented in the well. Plans called for the setting of 10,500 ft of 9⅝-in. and 13,500 ft of 7-in. casing.

No drill collars were used as the unit itself weighs about 8000 lb, and only 3000 to 5000 lb load was carried on the bit. A straight hole survey at the end of the test run indicated a maximum deviation of ¾ of 1 deg from vertical. The turbodrill was run on 5 9/16-in. fullhole drill pipe and equipped with a conventional 12¼-in 3-cone rock bit.

Drilling time averaged about 1¼ ft per minute. The rest of the time on bottom was spent in making connections and running the straight hole survey. Drilling time with a similar rock bit used in the conventional manner to drill the next 232 ft was about ½ ft per min, indicating the toughness of the shale section in the well and the favorable time made by the turbodrill.

The test was made in the Sohio-Sun No. 1 Nunez being drilled by the Kemp Drilling Company of Dallas and Shreveport. It was witnessed by Critchell Parson; George Wagner, Cecil Miller, and Michael Joel of the Engineering Development Company; Jake Haas of Spartan Drilling Company; Charles A. Long of Struthers Wells Corporation of Titusville, Pennsylvania; and Tom Sawyer and Keg Oliver of Kemp Drilling Company.

New Oilfield Film Released

A new 16-mm color-sound film produced by Black, Sivalls and Bryson, Inc. is "BS&B Products and Service to American Industry." Documentary in character, the film features BS&B products at work in the oilfields and equipment installation sequences, generously interspersed with scenic shots of the South and Southwest.

The film contains sufficient travel interest to hold the attention of student audiences. It has also been well received by "pre-view" audiences at technical society meetings. The film is available without cost to anyone interested in showing the film and may be booked by writing to Black, Sivalls and Bryson, Inc., 720 Delaware, Kansas City 6, Missouri.

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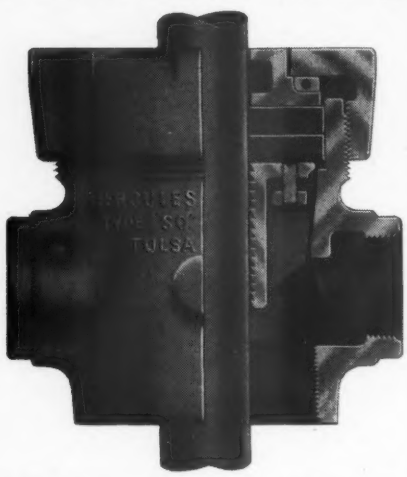

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Dovetailed end gate prevents "spreading"

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Unitized slip assembly speeds operations

THE BAASH-ROSS OPEN END TUBING SPIDER makes friends with production crews everywhere. They like its simple, quick installation without need for even breaking connections, if desired. They like its rugged tongue-and-groove construction that supports the heaviest loads without "spreading." And they particularly like the smooth operating efficiency and fast trips they can make with its unitized self-locking Slip Assembly.

Check over the unique features of the

BAASH-ROSS OPEN END TUBING SPIDER

DOVETAILED OPEN-END DESIGN

To install the Open End Tubing Spider, simply lift out the end gate, slide the Spider body around the pipe and replace the end gate. A bolt is provided for locking the body and gate together after the end gate is inserted.

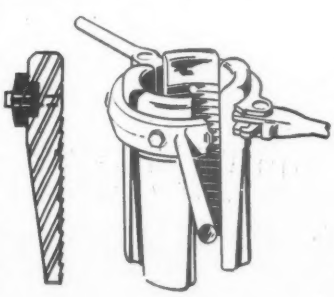
See those tapered tongues on each side of the end gate that fit into mating grooves in the Spider body? These form a tight *dovetailed* joint that will not spread under the heaviest loads!

And note above how the bottom flange on the body has slotted openings to facilitate bolting it to the top flange of the tubing head. The whole unit stays rigidly in place without slipping or sliding.

Another feature that speeds operations is the wide flat platform on top of the Spider body for supporting the Slip Assembly when it is out of the bowl. And there's a ridge around the outer edge of this platform to keep the slips from sliding off when standing open.

UNITIZED SLIP ASSEMBLY ASSURES UNIFORM GRIP

After the Spider body is in place the tubing job is ready to roll. And throughout the tubing operations, the unique features incorporated into the Unitized Slip Assembly save time, simplify work and safeguard the pipe against damage. . . .

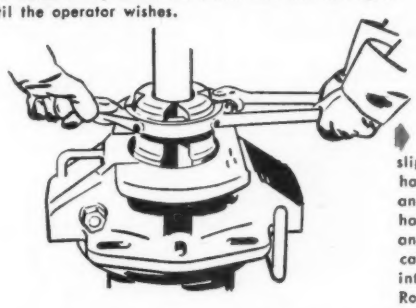


Note how the four slip segments are unitized together on a hinged tong so that they maintain exact alignment at all times. They grip together and release together, so that slip pressure around the tubing is uniform under all conditions. This eliminates swaging, kinking and other damage to pipe.

Note, also, that the slips are not merely bolted to the tong, but are grooved to fit solidly around the tong body so that all loads of holding the slips in exact alignment are transmitted directly from the slip bodies to the tong itself. No *shearing stresses of any kind* are placed on bolts or *other retaining parts!*

The Slips themselves are amply long—10" overall with a full 9" of gripping surface. This long gripping surface, coupled with the uniform all-around slip pressure provided by the unitized slip design, permits even the longest and heaviest tubing strings to be handled easily without risk of damaging the pipe.

A unique latch is provided that automatically locks the slips around the tubing as the handles are closed. To open this lock, the operator simply spreads the handles—no extra operations are necessary. Yet the lock holds firmly under all loads and will not open until the operator wishes.



And note how necks on the slip segments extend above the handles to provide ample clearance and protect the crew's hands against injury . . . still another feature that shows the care and thought that have gone into the design of the Baash-Ross Open End Tubing Spider.

These and other engineered features all add up to faster trips, safer operations, greater protection to pipe and higher all-around operating efficiency on tubing jobs of all types . . . at all depths!

The Baash-Ross Open End Tubing Spider is available in two sizes—one for handling tubing 3" in diameter and smaller, and the other for 4" tubing and smaller.

Available through leading supply stores.

WHAT'S DOING IN DRILLING

RECORD WILDCAT DRILLING IN 1949

An estimated 7250 wildcat wells were drilled by the petroleum industry in 1949, the greatest number in any one year since the discovery of oil in 1859, according to the American Petroleum Institute.

In 1948, the petroleum industry drilled 6728 "wildcat" wells. Thus the estimated 7250 drilled in 1949 represents an increase of 8 per cent over the preceding 12-month period.

The petroleum industry invested more than $350,000,000 in drilling these "wildcat" wells last year. As only one out of 5 were producers, the average cost of finding a productive "wildcat" well was about $250,000.

These costs do not include the sums paid to farmers and landowners for leases in the form of annual rentals and bonuses, nor do they include vast sums spent for geological and geophysical exploration, preparation of drilling sites, building roads and other expenses incidental to initial drilling operations. In fact, preliminary estimates show that the industry spent well over a billion dollars last year in exploring for oil and gas throughout the United States.

While actual figures covering the quantities of oil discovered by exploratory efforts of the industry in 1949 are not yet available, it is the consensus of leading geologists that substantial additions were made to proved underground reserves. At the beginning of 1949, the nation's proved reserves of liquid petroleum aggregated nearly 27 billion bbl. This represented a net gain over the preceding year of well over two billion barrels, even after the production in 1948 of over 2.1 billion barrels.

With more "wildcat" wells drilled last year than in any previous year, and with many new oil and gas fields proved reserves of liquid petroleum were doubtless substantially increased in 1949.

Oilmen are finding and developing new sources of oil supply in the United States at a two-to-one ratio over production, but the replacement costs are about five times greater than those experienced in pre-war years. Replacement cost of petroleum reserves today is a factor of far-reaching importance with respect to present and future financial returns of the industry. For the most part, the industry is producing oil discovered in earlier years when oil finding costs were low. To replace the reserves today costs five times as much. In other words, for every dollar's worth of oil taken out of the ground the industry must put $5 back into the ground as replacement cost.

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Drill Two Garvin County Wells

Garvin County, Oklahoma is still getting exceptionally good producers. Skelly Oil No. 3 Immohotichey flowed 574 bbl of oil, without any water, in 21 hours through a ¾ in. choke and is continuing to test.

Sinclair Oil and Gas Company has completed its No. 1 Rawson-McCoy Unit in Garvin County. The well flowed 343 bbl of 43.5 gravity oil in 8 hours through a 24/64-in. choke from perforations opposite the First Bromide sand. With the oil was 2,917,000 cu ft of gas a day for a gas-oil ratio of 2882 to 1. Casing was perforated between 7620-22 ft, 7546-56 ft, 7596-7614 ft, and 7646-48 ft.

Drilling in Illinois Basin

Production and development work in recently-opened fields featured drilling operations in the Illinois Basin in January. The No. 1 C. W. Moore, Alva C. Davis, and Russell P. Johnson wildcat in Richland County, Illinois is flowing at the rate of 33 bbl an hour through 2-in. tubing. Total depth is 3277 ft. A drillstem test on the well recovered gas in four minutes and flowed natural clean oil in 38 min.

Other wells begun are The Texas Company's No. 1 Noland, drilling below 500 ft and Wiser Oil Company's No. 1 Slunker, now drilling below 2400 ft.

Good wells are being completed about four miles north of St. Elmo in Fayette County, Illinois. Drilling is in the Cvpress sand, average depth is 1550 ft. Some of the wells make 200 bbl of oil a day when completed.

Douglas to Drill in Cuyama Valley Field

Douglas Oil Company of California has begun drilling operations in the rich Cuyama Valley field, where 185 wells now are in production.

Site for the company's initial well has been staked on a 200 acre lease, surrounded by land leased to Richfield, Honolulu, and Wilshire Oil Company, in Section 16, Township 9 North, Range 26 West. Drilling started around February 1, 1950. This well, situated approximately two miles southeast of the South Cuyama or Homan field, will explore a new area.

Present plans are to drill to a depth of 3500 to 4500 ft, in the expectation of reaching sand bearing high gravity oil. If the new Douglas well becomes a producer it will bear out the contention of some geologists that oil deposits in the Cuyama field are more extensive than was realized when the area was developed on a large scale last year.

Carter Is Leading Producer

For the fourth straight year, *The Link* reports, Carter Oil Company has maintained its position as leading producer in the area in which it operates, registering a 2.6 per cent gain over 1948 to an estimated 67,960 gross bbl daily. Preliminary estimates indicate that crude production in the operating territory served by Carter will average 1,429,200 bbl a day for 1949, a decline of 2.6 per cent under the 1948 average. *The Link* stated.

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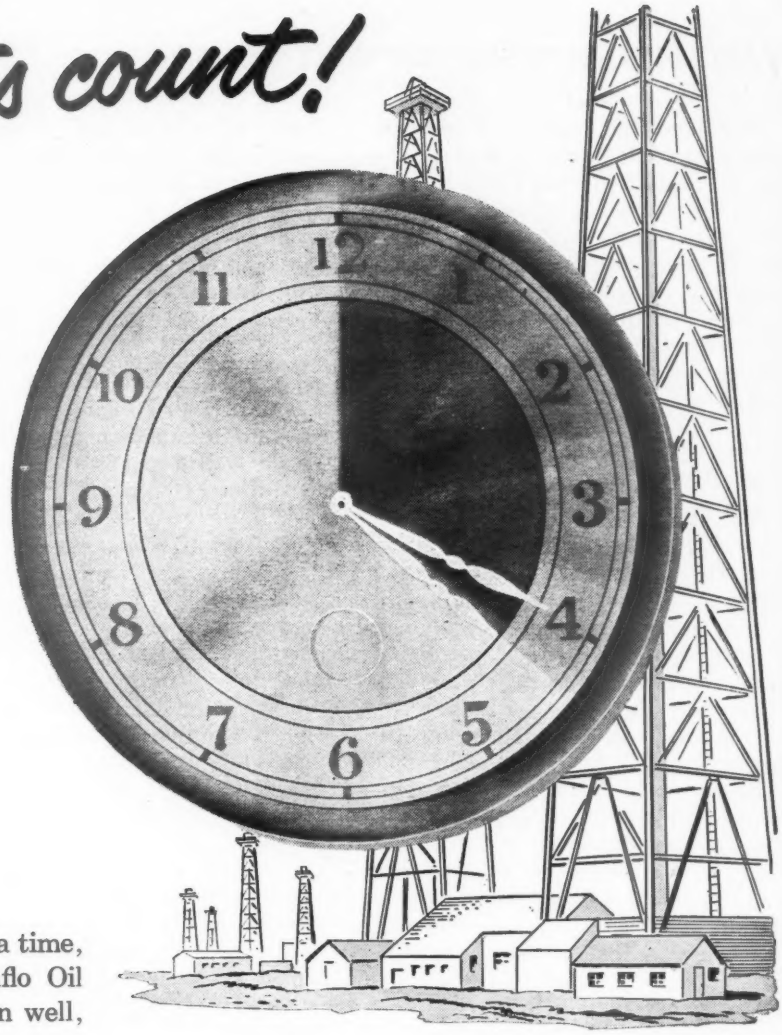

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VAN WINGEN DISCUSSES WELL SPACING

The American Institute of Mechanical and Metallurgical Engineers, Junior Section of the Pacific Petroleum Chapter held its first meeting of the year recently in Downey, California. It was opened by the newly elected chairman, Norman B. Clark, who introduced the program chairman and the secretary for 1950, I. A. Marshall, Jr., and Harold E. Nissen. He then turned the meeting over to the program chairman, who introduced the speaker of the evening, N. Van Wingen.

Van Wingen, who was formerly chief evaluation engineer for the Richfield Oil Corporation and more recently a professor of petroleum engineering at the University of Oklahoma, is now vice preseident of petroleum technologists, a group of consultants doing core analysis, production research, and reservoir engineering. He opened his talk by emphasizing that well spacing is a difficult and controversial problem being one of the major ones yet unsolved by the oil producing industry. It is also a very fundamental problem in that it greatly affects profit. The present group of young reservoir engineers tends to overlook the "straws," or the number of wells tapping a reservoir, which offers an extreme from the 1920's when the emphasis was on oil wells only, the speaker continued.

There are strictly two phases to the problem; one is economic and the other is physical. Some reservoir analysts consider only the physical aspects, however the major problem of production is not maximum volume, but greatest profit. Thus the operator's interest is at variance with the royalty owner or the people (statetism). Competition on offset leases or lease requirements may simplify the spacing problem as well as dictate the spacing. State laws may make it easy for an operator and also cause much controversy as in the Mid-Continent at the present time.

The economics involved in the spacing problem are simple and straightforward. It is obvious that an operator cannot drill as many wells for a given thickness of pay to 10,000 ft as to 300 ft. Factors involved are: Development cost, operating costs, royalties, value of oil, gas, and gasoline, present worth factor, and rate of withdrawal. The current income requirements or refinery demand may decide the spacing program in some instances. Thus we see that the economic angle, though complex, lends itself to accurate analysis except for such factors as the future price of oil and what money is worth. These last two factors the management or economists decide for us. If in doubt as to what to use as the value of the oil it is wise to use the current price because that can always be defended in court.

Mathematics appears to be a logical approach to physical recovery and its relationship to well spacing. If the oil is mined, which would be the case of an infinite number of wells, there would be 100 per cent recovery. On the other extreme, if no wells were drilled, there would be zero recovery. Many investigations have been made, but due to the complexity and the great number of variables involved no analytical or empirical rule formulated to date has received universal acceptance. There are two schools of thought regarding the question. Cutler and Tomlinson head up the group that believes that physical recovery is affected by well spacing. The major Mid-Continent oil companies are proponents of the theory that there is no effect. This difference of opinion is accentuated by politics. California is less prejudiced because there are no state laws regarding well spacing. Millions of dollars in capital outlay is involved in the question for some large operators.

Many notable papers have been written attacking the problem from both the empirical and analytical approach. All of these have been criticized by equally competent commentators. Stuart Clark has made the following comments on the empirical data: "Well spacing does have some effect upon the recoveries of oil obtainable from actual reservoirs within which fluid flow is through capillary openings, within the economic limits of operations. The effect will be very slight under conditions of very high pressure and temperature, high permeability and low viscosity or fluids in the vapor phase, but will be appreciable under conditions of low pressure and temperature, low permeability and high viscosity." This statement automatically excludes infinitessimal rates of production, production continued for infinite time, and "perfect" reservoirs.

In conclusion Van Wingen brought out that there is no dependable all inclusive formula to determine optimum well spacing and we know practically nothing about the relationship between well spacing and recovery. Well spacing is a practical realistic problem that must take into account both the theory and the economics.

Woodlawn Field Adds Well

Stanolind Oil and Gas' No. 1 Texie Davis, Watkins survey, in Harrison County, Texas has been rated for 58,500,000 ft daily through ¼-in. choke. Operators have not yet acidized. Production is from perforations between 6404-580 in the Pettit.

Drilling Notices Down

Oil field operations reported in California during the week ending January 21, 1950, show 27 notices to drill new wells filed, as compared with 41 notices the previous week. Of the 27 notices to drill new wells filed, 1 each was for wells in Aliso Canyon, Placerita, Whittier, and Wilmington fields, 1 in Los Angeles County, 1 in Ventura field, 5 in South Cuyama field, 1 in Santa Barbara County, 2 in South Belridge field, 1 each in Devils Den, Edison, North Coles Levee, Paloma, and Tejon Hills fields, 1 in Kern County, 3 in Raisin City field, 1 in Guijarral Hills field, 2 in Kings County, and 1 in Fresno County. Total new wells this year, 95, as compared with 188 at the same date last year.

Marr and Union Producing Completes Louisiana Producer

M. H. Marr of Dallas, Texas, and Union Producing Company have completed a second producer in the Big Island Wilcox sand pool, Rapides Parish, Louisiana. The No. 1 Beauboeuf flowed 210 bbl of oil daily through ¼-in. choke from 5127 to 5130 ft. Tubing pressure was 300 lb.

Diamond M Field Extended

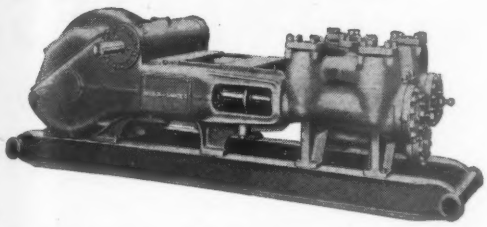
William Hamm, Jr., No. 1 Dee Myers has been completed for a daily flow of 1080 bbl of oil, extending the Diamond M (Canyon) field in Scurry County, Texas one mile north. Production was from perforations from 6820-40 ft and open hole from 6848-51 ft.

Gulf Opens Deep Sand

A new deep sand in the Quarantine Bay Field, Plaquemines Parish, South Louisiana has been opened by The Gulf Refining Company. It is the company's No. 1 State, Lease 1349, which flowed 200 bbl of 38-gravity oil daily through a 5/32-in. choke from 10,037 to 10,043 ft.

Anglo Drills 15th Well In Woodbend Section

Anglo Canadian Oil Company has announced the location of its 15th well in the Woodbend section of the Leduc field. It is the company's Home-Anglo Woodbend No. 17, and will be the last D3 attempt for Anglo and its partners, Home Oil Company and the Calgary and Edmonton Corporation, in the Woodbend section for some time.



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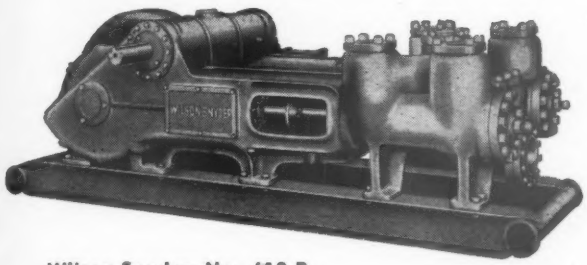

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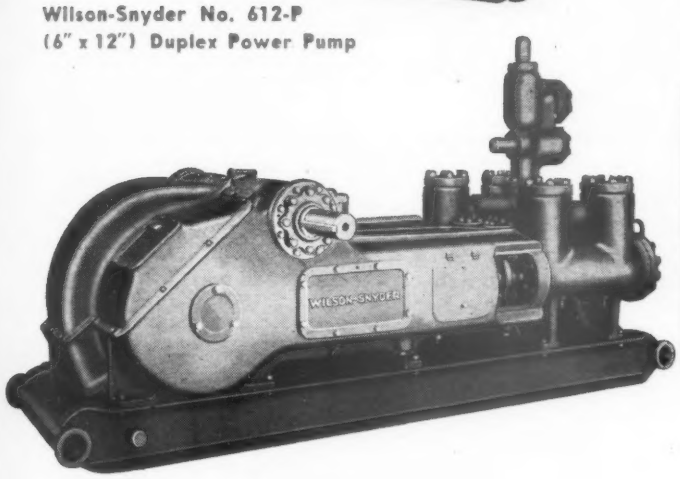
8P-HD	5" x 8"	3000	600	80	205	85
12P-LD	6" x12"	2000	365	70	395	100
612-P	6" x12"	3000	520	70	390	140
712-P	7¼"x12"	3000	550	70	580	220
14P-HD	7¼"x14"	4000	765	65	620	325



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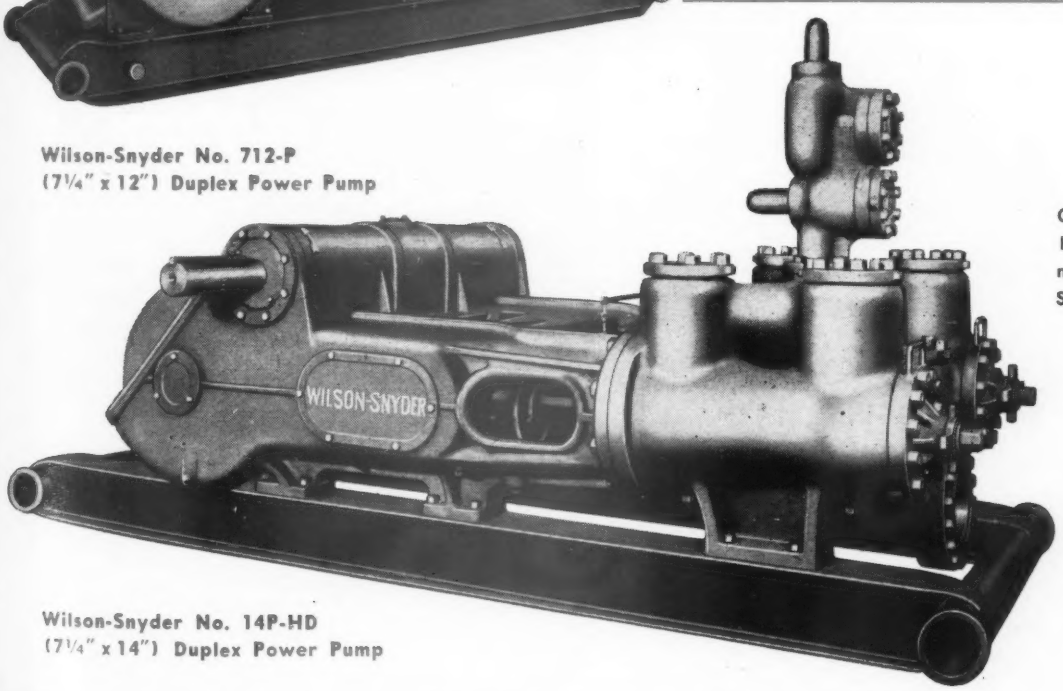

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EXPLORATION ACTIVITIES

Shackelford Wildcat May Be Pool Opener

A discovery well from a sand tentatively identified as in the Hope series is expected in Anderson and Word et al. No. 1 E. P. Armstrong, six miles northeast of Lueders in Shackelford County, Texas.

Pipe was run to 1825 ft after a show in the sand topped at that depth. Total depth is 1831 ft. After the six feet were cut, the well began filling up at the rate of 2 to 3 bbl of oil per hour.

Skelly Oil Gets Producer

Skelly Oil Company has a good producer in Stephens County, Oklahoma. Its No. 1 Frensley swabbed 528 bbl of oil in 14 hrs while swabbing and cleaning out at 7040 ft. Total depth is 7060 ft.

Opens Gas Pool in Indiana

National Associates Petroleum Company, Tulsa, Oklahoma, has opened a prolific gas pool with a well that blew out when it drilled into the Salem lime at 1120 ft, in Davies County, Indiana. After killing the gas flow, the company completed another well 50 ft away from the gas blow-out for a flow of 225 to 230 bbl a day of 40 gravity oil from the Fredonian formation to open a new oil pool at a total depth of 744 ft.

The well is the company's No. 1 Lockie Meurer topped at 740 ft last year. The company did not complete the well then but skidded the rig 50 ft and drilled No. 1-A Lockie Meurer to 1120 ft in the Salem lime when it blew out with gas. After killing the gas flow in No. 1-A Meurer, National went back to No. 1 and drilled it four feet into the lime when it started flowing 40-gravity oil. It is continuing that flow at a rate of about 230 bbl a day, making it an unsually good well at the shallow depth for the territory and opening a new oil pool. Flow from No. 1 is through a 1-in. choke.

Humble Completes Wildcat

Humble Oil and Refining has opened a new field in Los Angeles County, California. The No. 1 Newhall Land and Farming wildcat test flowed at a rate of 177 bbl of 30.6 gravity oil daily.

Two Oil Pool Prospects Show For Arkansas

In Western Rice County, Kansas, two oil pool prospects are showing. One and one-half miles west of the Ringwald pool, Sohio Petroleum Company and Derby Oil Company No. 1 Reif, is swabbing around 5 bbl of oil an hour from the Arbuckle.

Good oil shows were logged in the Lansing lime, the formation from which Ringwald pool wells produce. One mile northwest of the Ringwald pool, Robert L. Williams is testing the Lansing formation at No. 1 Arensman, with an oil show logged at 3146-54 ft.

Louisiana Pool Opened

A new South Louisiana oil pool has been opened by the California Company in Plaquemines Parish. The company's No. 1 North Main Pass Unit, flowed 30 bbl of 37.9 gravity oil daily through a 9/64-in. choke from 9026 to 9047 ft. Tubing pressure was 1525 lb and gas-oil ratio was 710 to 1. Total depth was 9813 ft.

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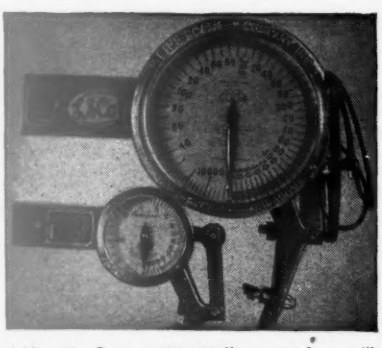

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Phillips Opens New Field

Phillips Petroleum Company has discovered a new oil field in its No. 1 Willclo well, which is on the west rim of the Anadarko Basin in Section 15, Block 3-T, T&NO Survey, Sherman County, Texas Panhandle. This new discovery well pumped 225 bbl per day of 40 deg gravity oil through perforations in the Pennsylvanian zone at 5844 to 5880 ft. Another potential oil zone was also encountered in the Pennsylvanian beds immediately above the new producing horizon.

Carter Wildcat Has Oil Show

A new oil field may be in the making for Washita County, Oklahoma. This seemed likely after Carter Oil et al ran drillstem test at a wildcat, Carter's No. 1 Galloway, a mile west of Rocky. The well ran 2-hr opening at 5305-55 ft in the Hoxbar section of the Pennsylvanian, to show gas in 50 min and recovered 780 ft of 28.2 gravity oil with 30 ft of oily gas-cut mud. It was being carried deeper.

Michigan Wildcats Completed

Two wildcat discoveries have been completed in Michigan. One is in Allegan County and the other in Saginaw County. Though not too important in themselves, they may lead to other development in Michigan which will be of importance.

Universal Drilling Company has a small 10-bbl well at the No. 1 Berry, Monterey Township. The hole was bottomed out at 1827 ft. In Saginaw County Graham Wilcox has a new Dundee zone discovery at the No. 1 Shaw, Birch Run Township. The well showed from 100 to 300 ft of free oil in 40 hr at 2522 ft and was reported to have flowed at the rate of 40 bbl a day on initial test after acid treatment with 1000 gal. Production declined 25 bbl daily.

Mexico Gets First Offshore Well

Signal Oil and Gas Company has completed its first offshore oil well in Mexico. It is the Tortuguero No. 1, flowing 36-gravity crude through a small restricted bean. No accurate estimate of the well's production is available as the well is cleaning up and is producing mud and sand in addition to clean crude oil. Production tests, however, revealed a potential of approximately 5000 bbl per day with an estimated 5,000,000 cu ft of wet natural gas. On the basis of previous production tests, Petroleos Mexicanos laid a pipe line from the field to their refinery capable of taking 20,000 bbl per day, and the first shipment of this oil has been made through this line.

The successful completion of this well is a culmination of years of effort by the Signal Oil and Gas Company in negotiating with the Mexican government and is the first well to be completed by the Mexican American Independent Company under contract with the Republic of Mexico. Signal Oil and Gas Company holds the largest interest in the combination of oil companies. Other interested parties in the venture are the American Independent Oil Company and Edwin W. Pauley, an independent operator.

Mississippi Delta Region Scene of New Discovery

Discovery of what may prove to be an important new oil field in the delta region of the Mississippi has been announced by The California Company, a subsidiary of Standard Oil Company of California. The announcement was made on completion of the company's North Main Pass Unit No. 1, about 26 miles northeast of the mouth of the Mississippi, and about four and a half miles east of the main channel.

On a 24-hr test through a 9/64-in. choke the new well flowed at the rate of 260 bbl a day of clean oil, 33.7 gravity. Production is from the Miocene, through perforations at intervals from 9047 to 9016 ft. Total depth of the well is 9808 ft.

Stanolind Opens New Pool

A new San Andres zone pool has been opened a half-mile south of the Howse (Tubb sand) field six miles south of Hobbs in Lea County, New Mexico by Stanolind Oil and Gas Company. The well flowed 99 bbl of oil a day through a 16/64-in. choke, with gas-oil ratio of 1326-to-1 after acidizing at 4276 to 4430 ft. Oil tested 29 deg gravity.

Drilling Continues in Wyoming

Continental Oil Company has opened a new oil pool in Wyoming. The company's wildcat in the Mead Creek area of Johnson, Wyoming, recovered 330 ft of oil in a 35-min test of Shannon sand and also showed for 100,000 ft of gas daily. The well is two miles south of the South Sussex field and opens a fourth new pool in the Sussex area. These pools produce oil from four separate formations.

Mountain Fuel Supply drilled a deep failure in the Church Buttes field of Unita and Sweetwater Counties, Wyoming. Drilled to 14,646 ft, the company hit salt water in the Nugget sand. This was the first operation below the Morrison sand. The well is being plugged back to the Dakota and will be completed as an oil producer.

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Gas Well Discovered In San Juan Basin

Herbert Herff, Memphis, Tennessee, has discovered what appears to be a new pool in the San Juan basin in New Mexico. The Oil Conservation Commission reports that the well gauged 1,400,000 cu ft a day when it topped the Mesa Verde formation—a greater showing than any other activity in the area at that drilling point. The discovery is expected to raise estimates of natural gas reserves in the basin and may enhance chances of the Federal Power Commission's approval of a New Mexico to California pipe line.

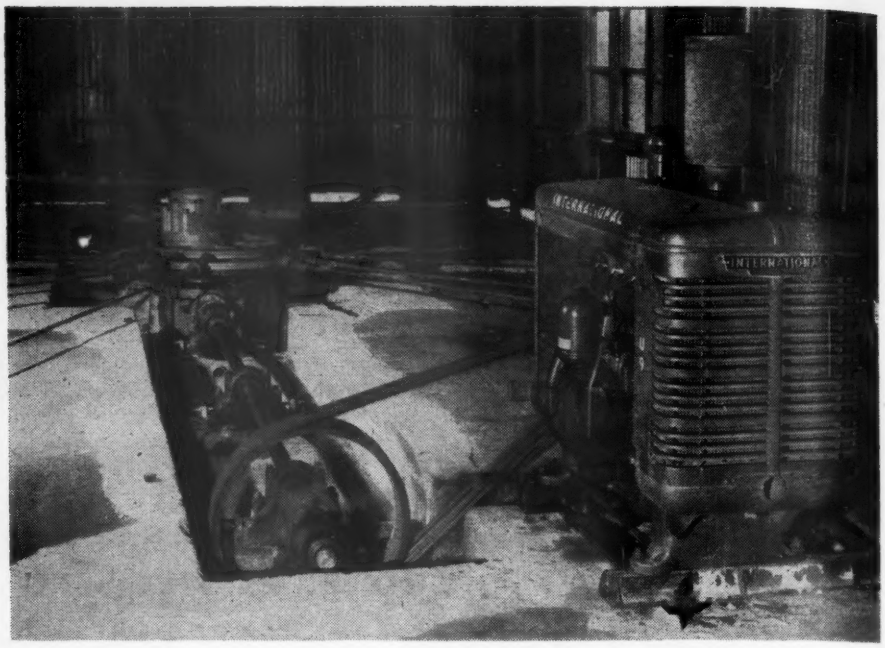
The well is about 10 miles east of Blanco and 34 miles east of Farmington. It tapped the Mesa Verde formation at about 4400 ft.

Tidelands Gas Field Opened

Magnolia Petroleum Company is opening another dry gas field in the Gulf of Mexico off the Louisiana coast. The company's No. B-1 State in the Eugene Island area off St. Mary Parish is reported to have produced dry gas, without a gauge, in perforations from 8449 to 9451 ft. Total depth is 14,048 ft.

Frio Sand Pool Opened

A new Frio sand pool apparently is being opened about ¾ of a mile off Orange in the Phoenix Lake area of Calcasieu Parish, Louisiana. Ohio Oil Company's No. 1 E. W. Brown, Jr. has recovered oil on two drillstem tests and reports say 9⅝-in. protection pipe is being set at 8015 ft. Operator will then drill to 10,000 ft.



J. F. Baker Oil Company, Breckenridge, Texas, uses this central power on its J. N. Stuart and Son lease in Cedar Brakes section of Palo Pinto County. Pulling 17 rod lines through a flat gear box,* the 55-hp enginet pumps fifteen 1700-ft oil wells. One rod line is connected to a counterweight and another to a pump supplying water to living quarters. The engine burns natural gas, and is operated 24 hr a day. It had been run continuously for 3600 hr without attention other than normal maintenance at time photo was taken.

*Oil Well.
†International U-9.

The Texas Company Gets Arkansas Wildcat

The Texas Company appears to have a pool opener at the No. 1 Krestin in Barton County, Arkansas, four miles southwest of the Axman pool. A one-hour drillstem test of the Arbuckle at 3561-68 ft recovered 62 ft of very heavily oil-cut mud.

Imperial Makes New Canadian Discovery

According to latest reports, Imperial Oil Company's new wildcat discovery in the Normandville area, Canada, may produce another oil formation. The well is the Imperial-Kathleen No. 1. Twenty-one miles southeast of the Normandville discovery and five miles northwest of Kathleen town, the well is on a separate reservation to Normandville and is presumably an entirely different structure.

If Normandville is in the normal Dolomite of the Devonian, and is not connected with reef formation, then a new area of Alberta may be open for exploration, and the Devonian underlying ¾ of the province would be prospective territory even in places where reefs were unlikely.

Arkansas Wildcat Discovery

C. H. Murphy and Company, El Dorado, Arkansas, has what appears to be a discovery well in the Smackover lime at its No. 1 Gregory. The well is situated about seven miles southwest of Cornie, in Union County, Arkansas. Nearest Smackover production is in the East Haynesville field of Claiborne Parish, Louisiana, about five miles to the southeast.

Smackover lime zone was topped at 9270 ft, with porosity at 9277 ft found in a core at 9275-83 ft.

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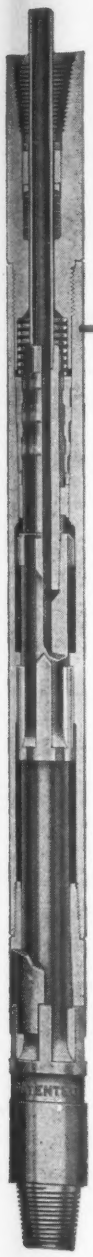
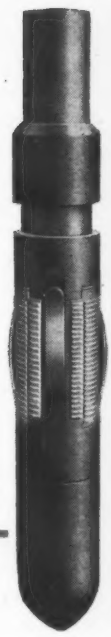
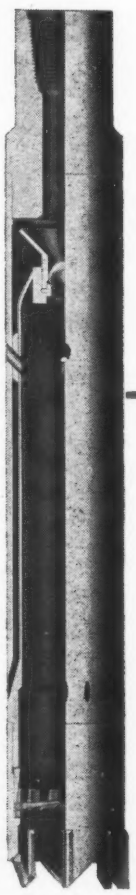


WHEN you have any type of fishing work—jarring, cutting, pulling, backing off, recovering junk, or any of a dozen similar jobs—put Bowen Fishing Tools to work on your rig!

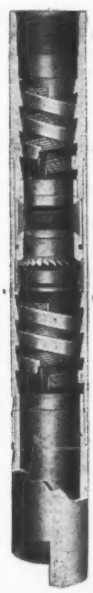
Bowen—through more than 30 years of engineering new tool designs, new improvements—has developed a complete line of fishing tools that help you speed the work . . . reduce the risk . . . and cut the cost on all your fishing operations. For your fishing jobs, get the important extra advantages of such features as . . .



A STRAIGHT-PULL FISHING JAR that requires no dangerous torque for operations, yet is fully adjustable for intensity of blow while in the hole, is faster in operation, has no delicate mechanisms. . . .



A SIMPLE, SAFE ROTARY SPEAR with a releasing mechanism that has never been known to fail on any job and with operating and construction features that make it ideal for all spear work. . . .



A RELEASING OVERSHOT incorporating a special spiral grapple that cinches tighter as pull increases and catches drill pipe, coupling or tool joint—whichever is up—without adjustments. . . .

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running tour with MEN IN THE INDUSTRY

▸ **Clarence M. Wanbaugh,** veteran Ohio and Michigan oil man, recently received a diamond-studded emblem in recognition of his 55 years of service with Sun Oil Company. He is Sun's drilling tool foreman for this district. The presentation was made by H. O. Cameron, of Toledo, Michigan production division manager and assistant to the Sun Oil vice presidents in charge of manufacturing and production.

Beginning his career as a well driller, Wanbaugh spent his early years in northwestern Ohio oil fields and was transferred to Saginaw in 1926 to supervise all Sun drilling in that district. He moved to Gladwin in 1937 and was active in the development of Buckeye and other fields in this area.

▸ **Marlow D. Melvin** has joined the Ryan Oil Company as geologist. He was formerly employed by Carter Oil Company for the past 10 years in that same capacity. His office will be in Evansville, Indiana.

▸ **Burrell Harrell,** general drilling superintendent for Fred M. Manning, Inc., was recently transferred to Breckenridge, Texas, where the company has established regional drilling headquarters. **Joe Christeeson** is assistant superintendent.

▸ **Douglas Weatherston,** San Antonio, Texas, consulting geologist, has been elected president of the South Texas Geological Society. Other officers, all of San Antonio, include: **John R. Sandidge,** Magnolia Petroleum Company, vice president; **Keith L. Rathbun,** Continental Oil Company, secretary; **Tom S. Gandy,** W. C. McBride, Inc., treasurer; and **Paul B. Hinyard,** Shell Oil and **Walter J. Boyle,** consulting geologist elected to the executive committee. **Marion J. Moore,** Sunray Oil Corporation and **W. W. Hammond,** of Ralph E. Fair, Inc., were named district representatives to the American Association of Petroleum Geologists.

▸ **Frank M. Brooks,** has been elected President of the Kansas Geological Society for the coming year. **Joseph R. Clair** was named vice president, and **Ralph Ruwwe,** secretary-treasurer. Current membership of the society is reported as 363, a substantial increase over 1948.

New officers of the Washington Geological Society are **L. H. Adams,** president; **Josiah Bridge,** first vice president; **W. L. Foshag,** second vice president; **R. E. Van Alstine,** first secretary; **Lloyd G. Henbest,** second secretary, and **Mrs. C. M. Warshaw,** treasurer.

▸ **Martin G. Kale,** assistant district production foreman at Shidler, Oklahoma, Sinclair Oil and Gas Company, was transferred to Lindsay, Oklahoma, in the same position. Other changes in the production department are: **Gibson S. Romberg,** named division petroleum engineer at Corpus Christi, Texas; **George R. Kelsey,** petroleum engineer at Oklahoma City, named senior petroleum engineer there; **Farrell F. Thompson,** petroleum engineer at Pampa, Texas, named district foreman there; **John F. Butler,** gang pusher at Bairoil, Wyoming, named assistant district foreman; and **Mahlon F. Manville,** geologist at Baton Rouge, Louisiana, named petroleum engineer at Gainesville, Texas.

▸ **Hugh Burchfield,** geologist, is in charge of new divisional offices opened in Albuquerque by Standard Oil Company.

▸ **Robert W. Landes** will assume duties in Calgary, Alta., Canada, as assistant manager of exploration for Imperial Oil, Ltd. He will work under **Ray Walters,** manager. Landes has recently returned from Peru, where he has been serving as divisional chief geologist at Negritos for International Petroleum, Ltd., which he joined in 1938.

Attending a safety committee meeting of American Association of Oilwell Drilling Contractors are, seated: Robert Dalgleish, Big Chief Drilling; J. S. Bell, W. H. Black Drilling; Harold L. Rowley, Big Chief Drilling, Mississippi, committee chairman; J. Doyle Settle, A.A.O.D.C., Dallas, committee secretary; John S. Jackson, Danciger Oil and Refining, committee vice chairman, and Sam King, Kerr-McGee Oil Industries, Inc. Standing: Claude Pipes, Texas Employers Insurance Association; H. B. Zigler, Halliburton Oil Well Cementing; Roy Dishman, Hunt Oil; Fred Claiborne, Stanolind Oil and Gas; C. W. Yancey, Rowan Drilling; G. W. Hutcheson, Geo. P. Livermore, Inc.; C. E. Louden, Employer's Mutual Insurance; J. C. Anderson and W. W. Duncan, Loffland Brothers, and F. C. Cooper, Sohio Oil Co.

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EXPORT OFFICE: 30 Rockefeller Plaza, New York 20, N. Y.

▸ **Richard Bard,** formerly manager of Shell Oil Company's gas-gasoline department at Tulsa, Oklahoma, has been made assistant manager of the crude oil department in charge of volatiles, in the company's New York office. He has been replaced in Tulsa by **Ruel Harris,** a member of the crude oil department in New York for the past year.

▸ **E. R. Barnett,** drilling superintendent for Superior Oil Company in the Rocky Mountain region, has been transferred to a similar job with Rio Bravo Oil Company, Ltd., Canadian affiliate to Superior. His Casper position has been taken by **Tom Simmons.** Barnett was in charge of drilling the world's deepest hole at Pacific Creek, Sublette County, which went to 20,521 ft.

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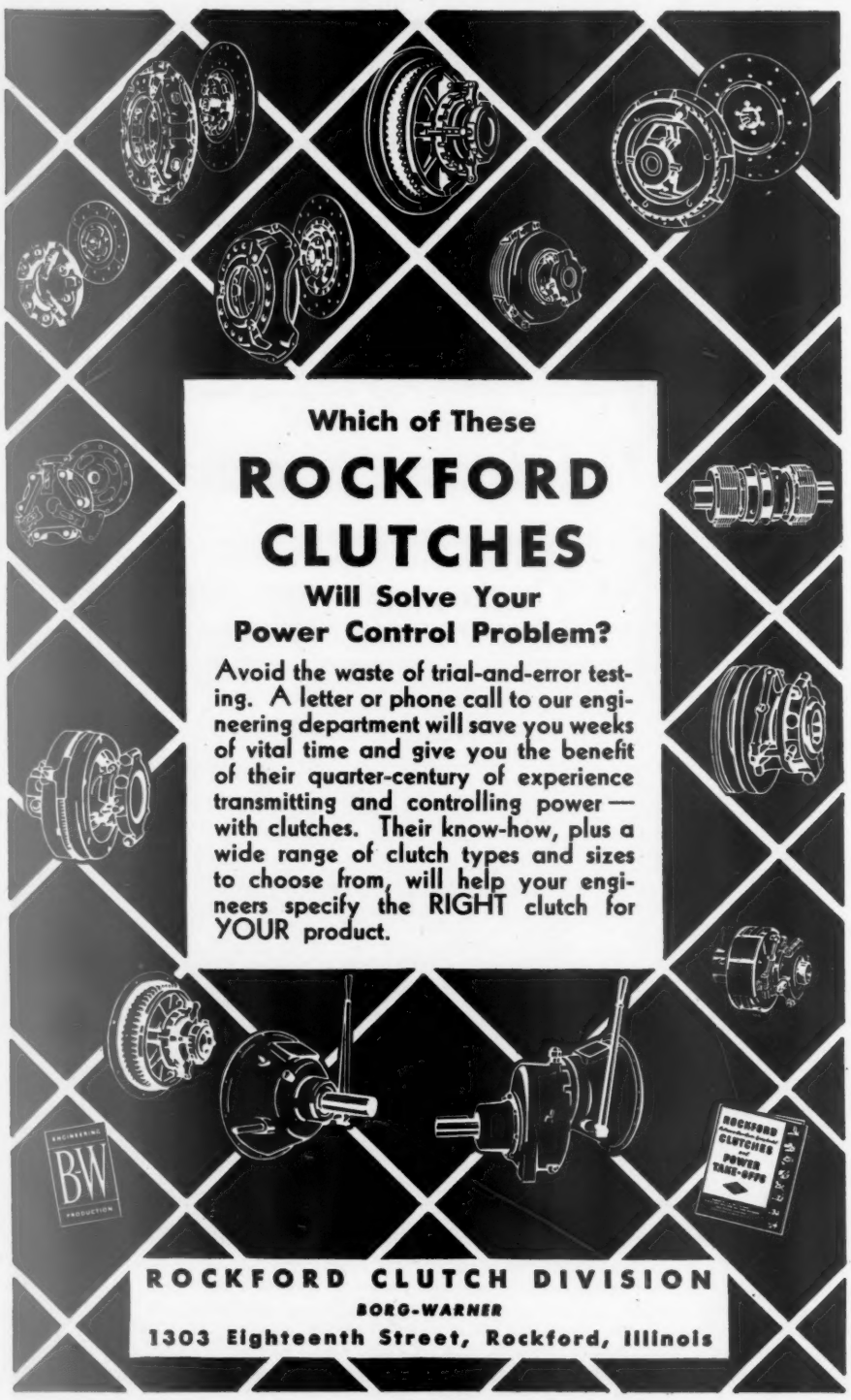
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▸ **J. M. Vetter** was elected a director and member of the executive committee of the Pan American Production Company and the Pan American Gas Company by the boards of directors of the two companies in New York. Vetter was advanced on December 28, 1949, from assistant manager of Pan American Production Company to vice president of that company.

J. M. Vetter

▸ The Society of Exploration Geophysicists has announced the following nominees for executive offices of the national organization for the year 1950-51. For president: **George E. Wagoner,** of The Carter Oil Company, Shreveport, and **Maurice Ewing,** of Columbia University, New York; for vice president, **Dayton H. Clewell,** of Magnolia Petroleum Company, Dallas, and **Sigmund Hammer,** of the Gulf Research and Development Company, Pittsburgh; for secretary-treasurer, **Francis F. Campbell,** of Amerada Petroleum Corporation, Tulsa, and **William H. Courtier,** of Phillips Petroleum Company, Bartlesville.

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Harvey Lee, formerly production superintendent of the Brownfield producing district, has been transferred to the Salem, Illinois district. There he will also be production superintendent.

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Measure any other pressure control equipment against the advantages of the

SHAFFER COMBINATION ROTATING BLOWOUT PREVENTER AND STRIPPER

There's only one way to fully appreciate the unequalled pressure protection you get in the Shaffer Combination Rotating Blowout Preventer and Stripper . . . that's to measure—point-by-point—*any other* equipment on the market against the unique operating features incorporated into this unusually effective unit. For example . . .

MEASURE FOOL-PROOF DEPENDABILITY!

The Shaffer Combination Rotating Blowout Preventer and Stripper maintains its leak-proof seal *continuously* while pipe is in the hole. There is nothing to *operate*, nothing to *remember*, nothing to *forget*, when sudden pressure emergencies occur. The unit is *always* sealed off around the drill string, ready for instant protection against pressure blowouts!

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When the drill string is in the hole, adjustment to different diameters and shapes in the string is *completely automatic*—no manual operations are necessary. When running large tools such as bits or reamers through the unit, simply pull a spring latch, rotate the bonnet 1/6 turn and the entire internal mechanism as a unit can be withdrawn to permit removal of the tools. Simply reverse the operation when going back into the hole.

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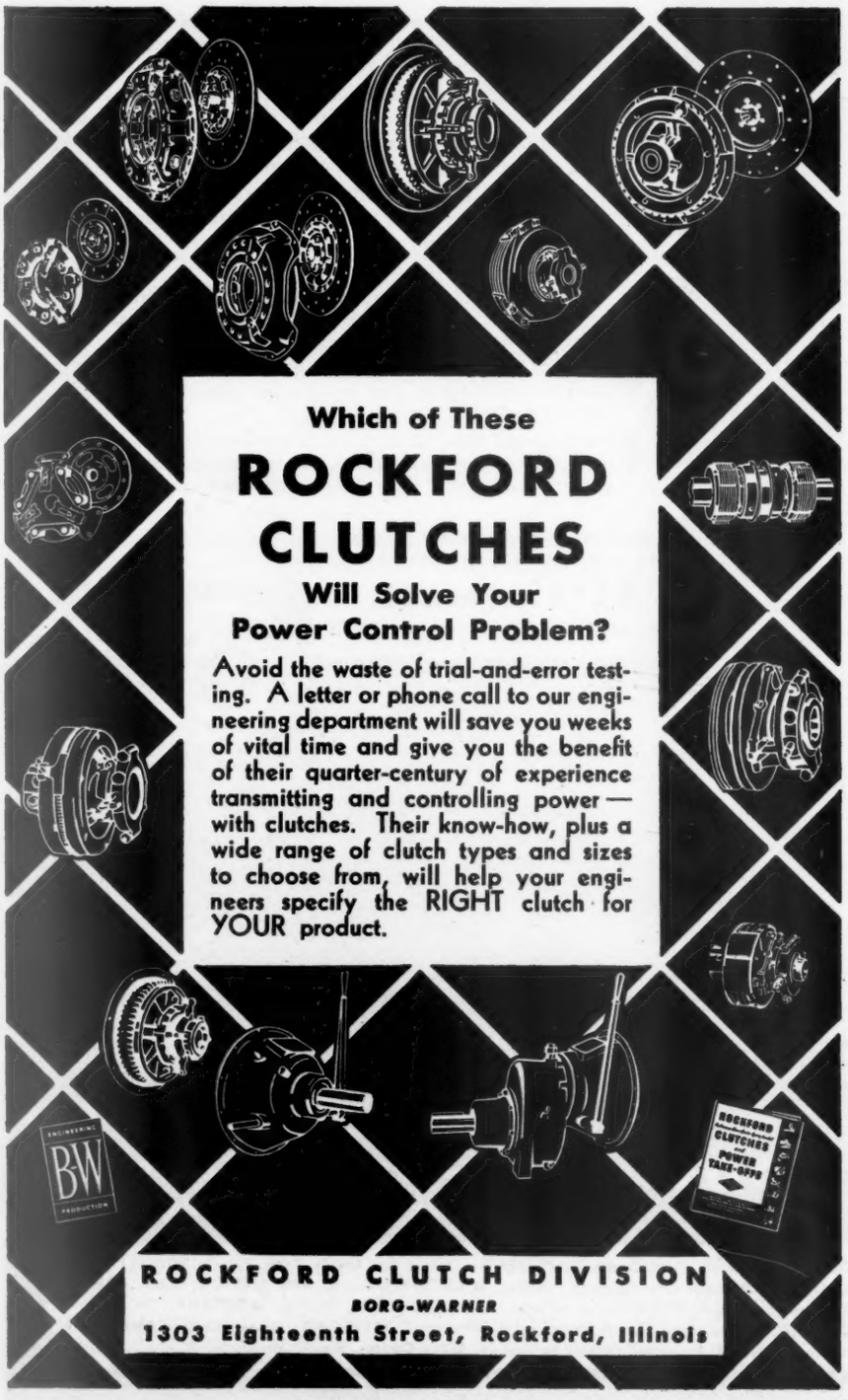
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EXPORT SALES OFFICE: Shaffer Tool Works, 500 Fifth Avenue, New York, N. Y., U.S.A.

▸ **George M. Clement,** who has been with The Texas Company 16 years, has been promoted to departmental geologist, producing department. Clement, who started with the company as a geologist at Shreveport, Louisiana, in 1933, was advanced from assistant departmental geologist. His office will be in Houston, Texas.

He was graduated from the University of South Dakota with the BA degree in 1928. After working for Shell Oil Company as an assistant geologist, he was employed as a graduate assistant and research assistant at the University of Iowa, Iowa City, Iowa.

In 1943 Clement was moved to the producing department manager's office, Houston, as a geologist. He was named senior geologist in 1945, and assistant departmental geologist last year.

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Producers appreciate a man —or a machine—who takes orders willingly and carries them out without hesitation or confusion. Jensen pumping units, backed by 30 years experience, do just that: lift oil year in and year out with only routine maintenance.

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Henry J. McAdams, president elect, New York Chapter of Nomads and James W. Reed, outgoing president.

▸ **Harry C. Meyer** died recently at his home in Garden Grove, California. He was assistant general production superintendent of Signal Oil and Gas Company. He joined the Signal organization in 1936 following several years in production work in the Signal Hill area with Western Oil and Refining Company and others.

▸ **S. D. Williams** has been appointed assistant controller of the Sohio Petroleum Company. He will remain in charge of the production accounting department in Oklahoma City. Williams has been with The Standard Oil Company of Ohio and its affiliates approximately ten years.

▸ **Critchell Parsons,** president, Engineering Development Company, Dallas, Texas, gave a talk, titled "Turbodrill" at a recent meeting of the Dallas Petroleum Engineers Club.

▸ **Clayton N. Nygaard,** assistant superintendent of producing operations for Standard Oil Company (Ohio), at Russell, Kansas, has been appointed superintendent of operations for the Shreveport, Louisiana district. **Floyd J. Rosenlieb,** formerly field production superintendent, West Edmond Hunton Lime Unit, Edmond, Oklahoma, has been named superintendent of production for the company's Evansville, Indiana district.

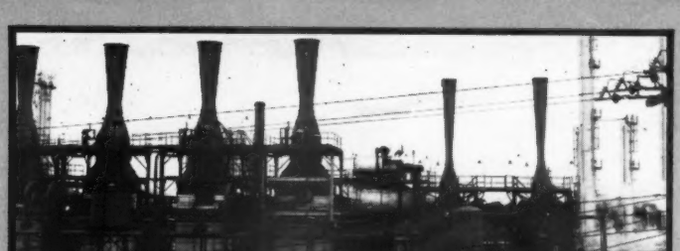
▸ New officers were elected at a recent meeting of the New York Nomads. Officers include: Henry J. McAdams, president; Howard B. Book, vice president; Ed. T. Landgraff, secretary; Fred J. Jobst, assistant secretary; Maurice F. Delano, treasurer; John D. Evans, assistant treasurer; Kenneth D. Demarest, sergeant-at-arms, Eugene R. Smoley, assistant; and Val R. Wittich, Jr. and Russell D. Heath, regents.

▸ **John W. Vanderwilt,** consulting geologist of Denver, Colorado, has been named president of the Colorado School of Mines at Golden to succeed **Ben H. Parker.** Parker has submitted his resignation to take effect April 1. Vanderwilt will continue some of his consulting work in the field of mining and engineering geology.

J. W. Vanderwilt

Vanderwilt was graduated from Penn College in Iowa, and holds a MS degree from the University of Michigan, and a doctor of philosophy degree from Harvard University. Parker became president of the Colorado school in 1946. At that time he was vice president of the Frontier Refining Company, and will return to that company.

REFINING AND GAS PROCESSING SECTION



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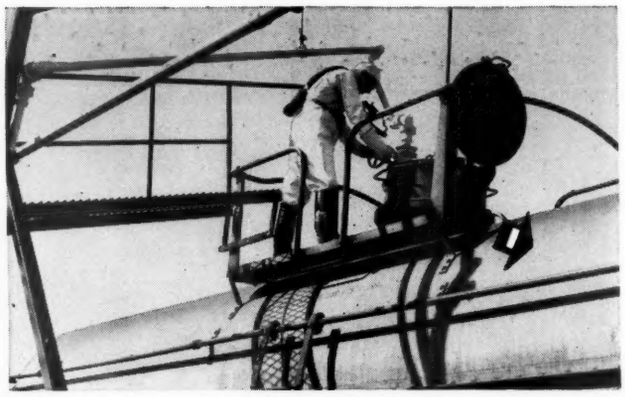

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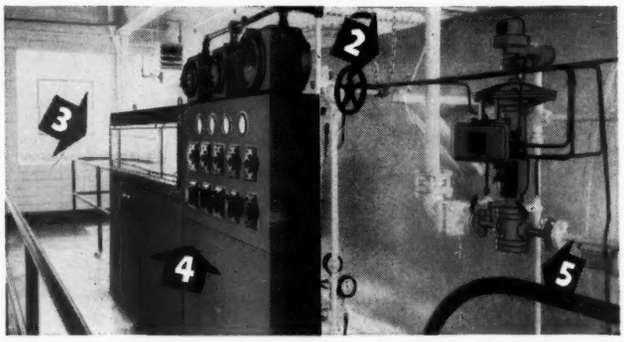

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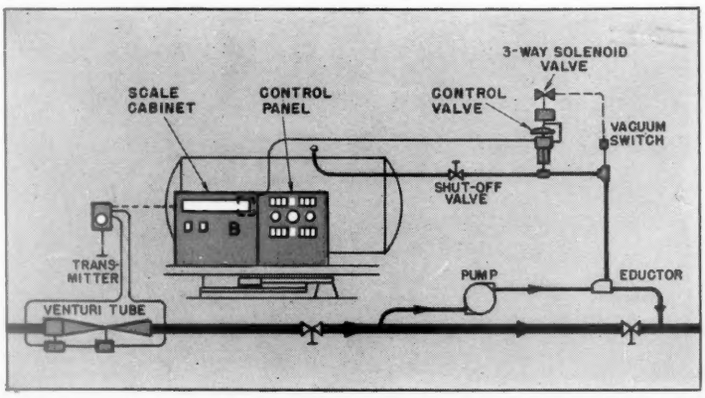
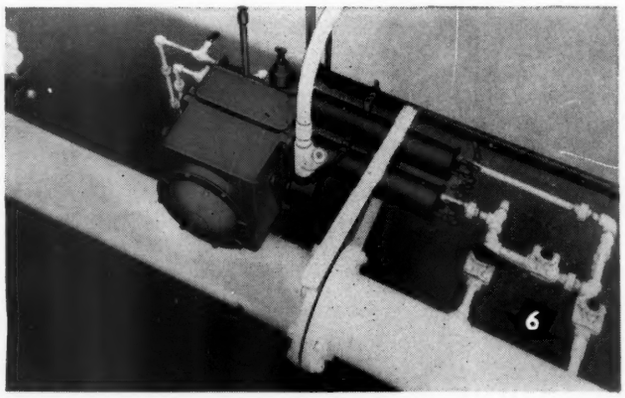


All equipment shown red in photos and flowgram furnished by %Proportioneers, Inc.%



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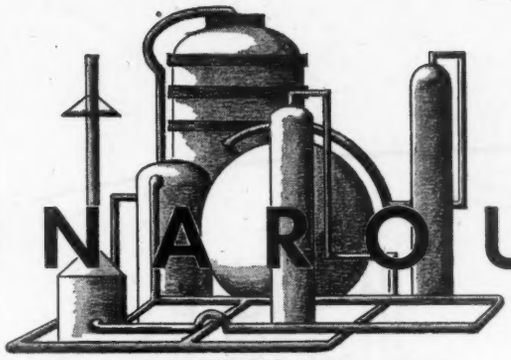


The Acorn — and the Oak

IT IS PROBABLE that the greatest good to the oil and automotive industries, and to the world, resulting from the discovery of tetraethyl lead as an anti-knock agent in motor fuels is not the direct one of saving in fuel consumption or of increased power output, but in the intensification of research in all allied directions in the field of power generation from hydrocarbon fuels. So we may conclude definitely from the remarks by GM's Dr. T. A. Boyd, on the occasion of the conferring of the Horning Memorial Award on him by the Society of Automotive Engineers early in January, in recognition of distinguished service in the field of engine and fuel mutual adaptation.

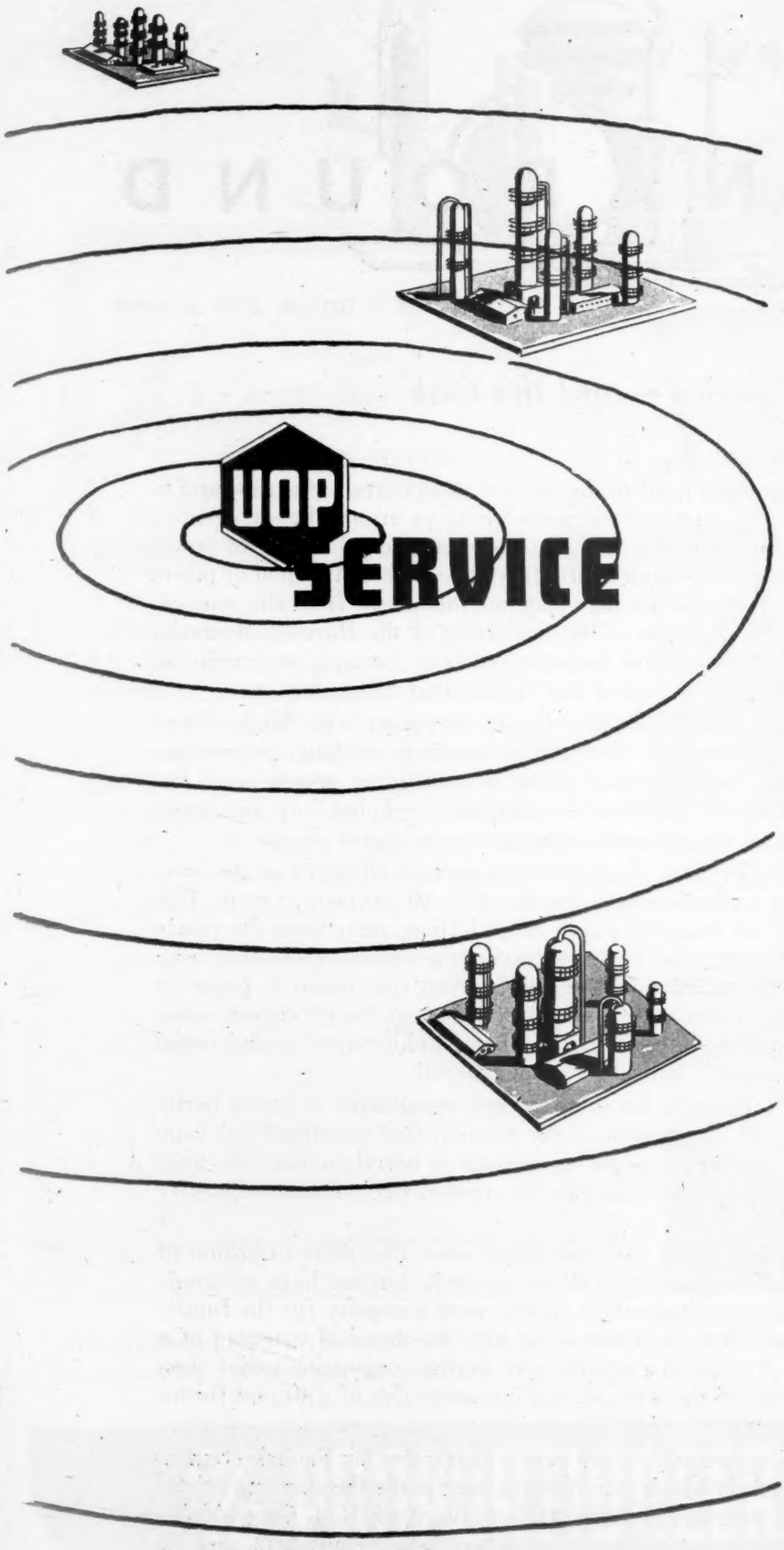
"Through what all it has done," said Dr. Boyd, discoverer with Midgley and Kettering of TEL'S anti-knock properties, "to stimulate catalytic cracking, polymerization, isomerization, alkylation, and other new forms of petroleum processing it has helped to bring about the modern revolution in petroleum refining." In his paper Boyd implied an analogous and simultaneous rejuvenation in engine design.

As a result of all this development, since 1930 the average efficiency of the automotive engine in ton-miles per gallon has been increased by 30 per cent or more. This represents an annual saving to the American public of $2 billion, many times the yearly cost of refining and engine research. This results in saving the annual production from 1500 oil wells producing 1000 barrels of crude daily. And this research began in 1916 in an old tobacco storage barn, with a single cylinder air-cooled engine, some nails and some carpenter's building lath, a strip of photographic paper wound round a tomato can, and an optical knock "indicator" from Britain!

The effect on petroleum refining in the up-to-the-present ultimate is shown partly by the fact that in World War II 70 per cent of the aviation fuel consumed was composed of synthetic hydrocarbons made in terms of millions of barrels weekly, the anti-knock properties of which had been determined by the most meticulous and exhaustive research.

All important in this picture is the fact that Boyd states that mere extension of knowledge is by no means the be-all and end-all of research; but the huge economic gains realized up to now make experimentation all the more necessary for the future. We have yet a long way to go; little is known as to why the chemical structure of a hydrocarbon molecule causes it to act in a specific way during combustion under compression. Far too little is known of the ways of making molecules of different forms. The researchers shall have no rest.

What can be done with engines and motor cars is illustrated by the achievement by Shell Oil's Mileage Marathon in which expert teams have made the startling record of 150 miles per gallon of commercial premium fuel on the road. R. J. Greenshields summarizes the techniques employed; elimination of accessory equipment, use of optimum speed, gear ratio, compression ratio, fuel-air mixture, and an accelerate-coast method of driving are only a few of the tricks.—ALF.



Globe Boosts Capacity With Fluid Cat Cracker

By G. G. Woodruff
Secretary, Globe Oil & Refining Co.

BY REPLACING a thermal cracking plant with the most modern type of fluid catalytic cracking unit and a gas concentration system, a major step has been taken in expanding the motor fuel producing capacity of our refinery at Lemont, Illinois, and substantially improving the octane rating of our gasoline.

G. G. Woodruff

The flexibility of the cat cracker also enables us to increase the yield of other light products, notably domestic furnace oil and diesel fuel, for which there is a growing demand. Production of heavy fuel oil, which is less desirable, has been reduced. With these improvements our refinery is in position to meet not only present octane requirements, but those anticipated in the forseeable future.

Unit Designed by Universal

When the installation of catalytic cracking facilities was first under consideration, all available processes were investigated from the standpoints of construction cost, yield and quality of gasoline and other products to be obtained. After thorough study, the design and engineering of the new facilities were entrusted to Universal Oil Products Company. The new unit, with a design capacity of 6,000 b/d, was placed on stream in early January.

Our Overall Operation

About 9,000 b/d of a mixture of West Texas, Wyoming and Gulf Coast crudes are charged to a combination atmospheric and vacuum distillation unit which produces about 2,800 b/d of gas oil. Approximately 22,000 barrels of a mixture of Illinois, Kansas and Gulf Coast sweet crudes are charged to a combination topping and gas oil cracking unit which produces about 3,200 barrels of a mixture of straight-run and cracked gas oils. The two gas oil streams, amounting to 6,000 barrels, are cracked in the new unit.

The overall refinery operation, including topping, cat cracking, desulfurization, thermal reforming and catalytic polymerization, produces about 17,800 b/d of gasoline or approximately 1,000 barrels more than was produced prior to the installation of the cat cracker. About 7,000 barrels of this gasoline are brought to Ethyl grade with 0.6cc of lead as compared to 1.8cc which we formerly used, while 10,800 barrels are marketed as housebrand gasoline with the addition of 1.1cc of lead. Other pro-

(Advertisement)

ducts are kerosene, diesel fuel, tractor fuel, furnace oil, heavy fuel oil, asphalt and road oil.

Here is a comparison of the yield from our old thermal unit and that which we expect from the fluid unit:

	Thermal Cracking		Catalytic Cracking (50% Conversion)	
	Bbl.	%	Bbl.	%
Gasoline (C_4 to 400°F)	1680	27.9	2860	47.8
Light fuel	1020	17.0	1800	30.0
Heavy fuel	3220	53.6	1200	20.0
Gas (Fuel oil equiv.)	186	3.1	440	7.3

The cat cracker is of the general UOP design with the reactor supported by a skirt set on the regenerator and with the stripper hung from the side of the reactor. The new graphic type control board, developed by UOP will be installed.

Low cost and reliable electric power is available to Globe, hence motor drives are used for the air blower and the gas compressors, as well as for most of the pumps. This results not only in lowered utility costs but also in a decrease in capital cost and maintenance.

Steam is used by the process for stripping catalyst and side cuts. This is exhaust from the main column bottoms circulating pump — the only turbine driven pump on the unit. A small amount of reboiler steam is also used for a few small reciprocating pumps and for a small reboiler in the gas recovery unit.

The Gas Concentration System:

Steam is generated from waste heat in the regenerator flue gas and the column bottoms. After furnishing steam to the catalytic cracking and gas recovery units, about 10,000 lb./hr. is supplied the refinery for use in crude and vacuum units. The gas concentration system is of the deethanizer type. Its two functions are the preparation of feed for the catalytic polymerization unit and the debutanization of catalytically cracked gasoline; hence, it is designed for maximum recovery of propane.

The system consists of a compressor section, a deethanizer and a debutanizer. Two existing towers were adapted to the deethanizer service.

In operation, the gas from the catalytic cracker receiver is compressed in two stages to 200 lb. per square inch and is charged to an absorption type deethanizer. The overhead from this tower is ethane and lighter gas which is discharged to the fuel gas line. The bottoms are charged to the debutanizer which operated at 150 lb. pressure. The debutanizer overhead is composed of C_3C_4 fractions, which constitute the charge to the poly unit. The bottoms normally are debutanized gasoline. The unit is designed for very high heat efficiency, reboiler requirements being supplied almost entirely by heat exchange from a cat cracker side-cut and debutanizer bottoms.

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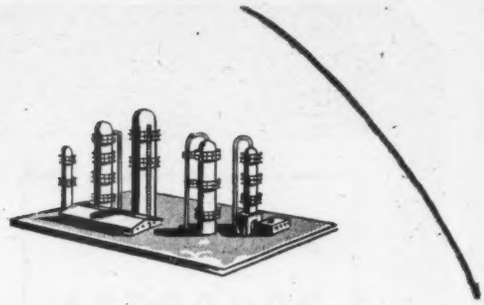

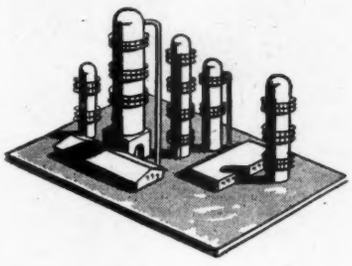

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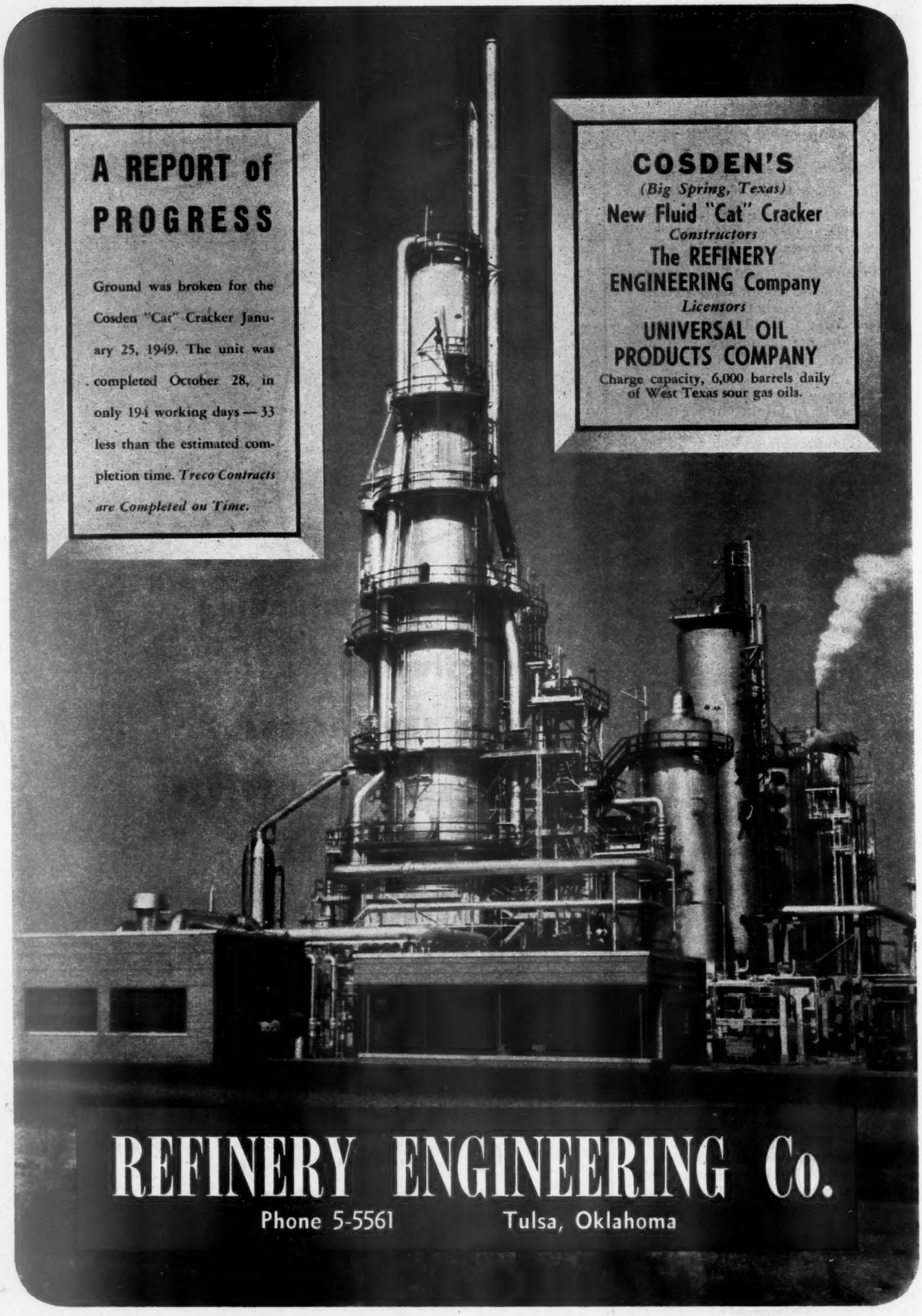
A REPORT of PROGRESS
Ground was broken for the Cosden "Cat" Cracker January 25, 1949. The unit was completed October 28, in only 194 working days — 33 less than the estimated completion time. Treco Contracts are Completed on Time.
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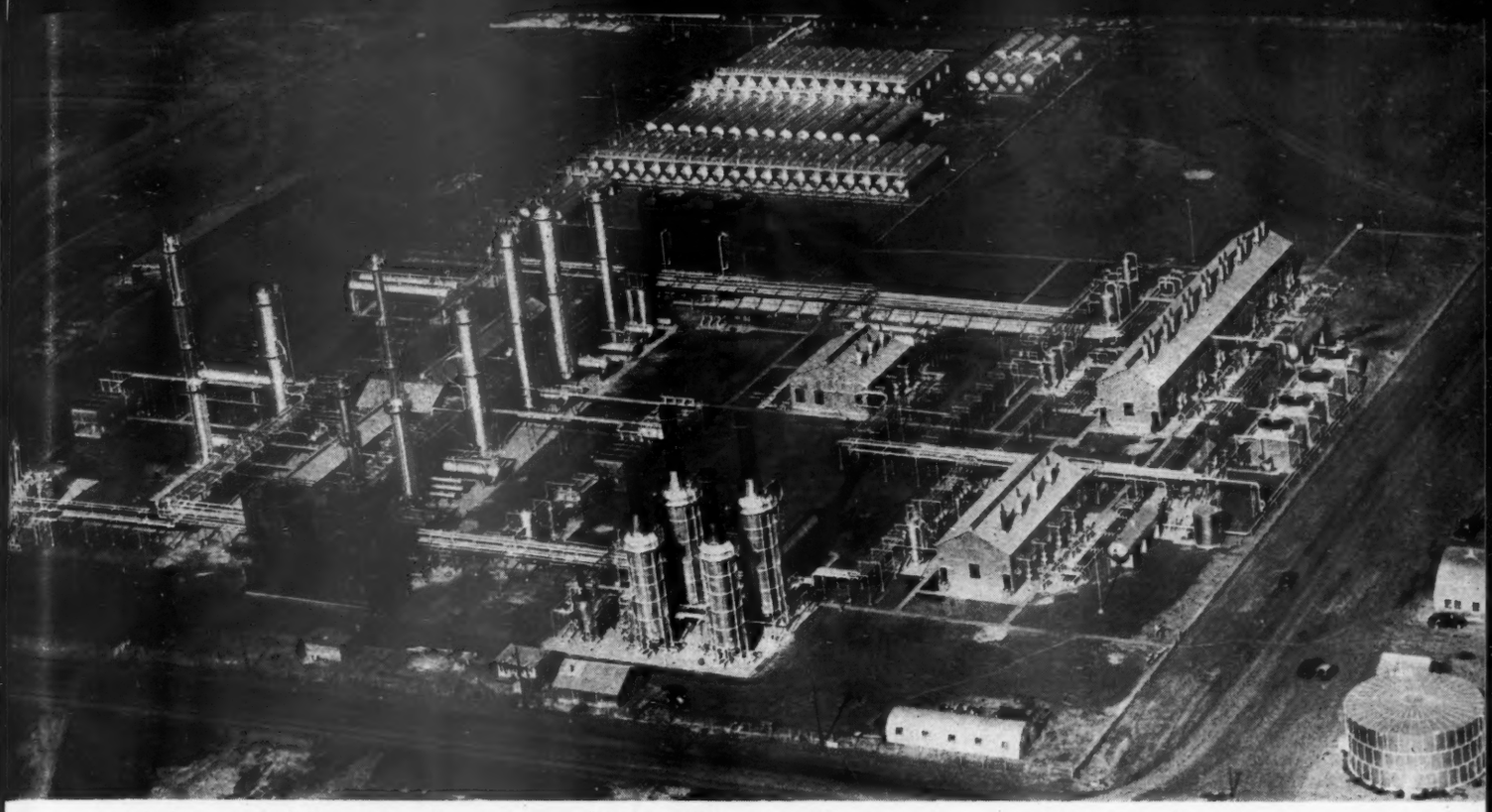


Aerial view of the Warren Petroleum Company's Maysville unit, looking east, shows the inducted draft cooling towers and the direct-fired oil furnaces in the foreground, the distillation and fractionation equipment at the left, the compressor building and auxiliary equipment at the right, and the plant storage for natural gasoline and liquefied petroleum gas in the background.

P 773.

Maysville Plant Serves "Golden Trend"

ARCH L. FOSTER*

A VERY unique assembly of plants, "The Garvin County Plants," and an outstanding collaboration plan entered into by five producing companies as a joint venture to handle their common interests are the most important developments in Oklahoma's newest major oil and gas producing section, the so-called "Golden Trend Area." This area includes six pools, Antioch, Elmore, Lindsay, Maysville, New Hope, and Wayne. Three plants, operating as one large integrated plant, have been built to handle the gas from these fields. These plants include the compression and absorption units at Antioch and at Lindsay, and the main plant intermediate between the Maysville plant.

Five companies cooperating in this venture in economical and efficient gas processing are Carter Oil Company, Cities Service Oil Company, The Texas Company, J. E. Crosbie, Inc., and Warren Petroleum Corporation. Warren was selected to build and operate these plants for the combine.

One most interesting phase of the design of these plants is the common and continuous circulation of absorption oil from Maysville the central unit to Lindsay and to Antioch plants, each about 7½ miles from the main plant. Rich oil from all three plants pass through the common processing units including the still and the fractionating and rectifying towers at the Maysville plant. Provision was made in the design to handle up to 80,000,000 cu ft of raw gas per day. At peak production the main plant will recover from the rich or "fat" oil from the three absorber units more than 300,000 gal of liquid products per day.

To effect this great production of light hydrocarbons, the design provided more than 200 miles of pipe lines, varying in sizes from 2-in. to 30-in. diameter. These lines handle gas collection, injection of residue gas back into formations; liquefied petroleum gases to loading units, gasoline, water, oil, etc.

To handle the gas production from about atmospheric pressure to 760 psig requires the use of 21,200 compressor horsepower, three-stage gas-engine-driven Clarks. Cooper-Bessemer gas-engine-driven pumps handle rich oil and other liquids, in 500 hp units, at up to 1000 psig discharge. Ingersoll-Rand electric generators furnish the current for the plant; these several services require nearly 9000 gas-engine horsepower. Included in the compressor capacity mentioned above is the handling of 25,000,000 cu ft of residue gas returned to formation at 2400 psig.

EXCLUSIVE

*Refining and Gas Processing Editor.

H. E. Felt, vice president, LPG sales, Warren Petroleum Corporation, talks to H. J. Bourke, superintendent Maysville plant, and Clifford Brady, Garvin County plants project engineer.

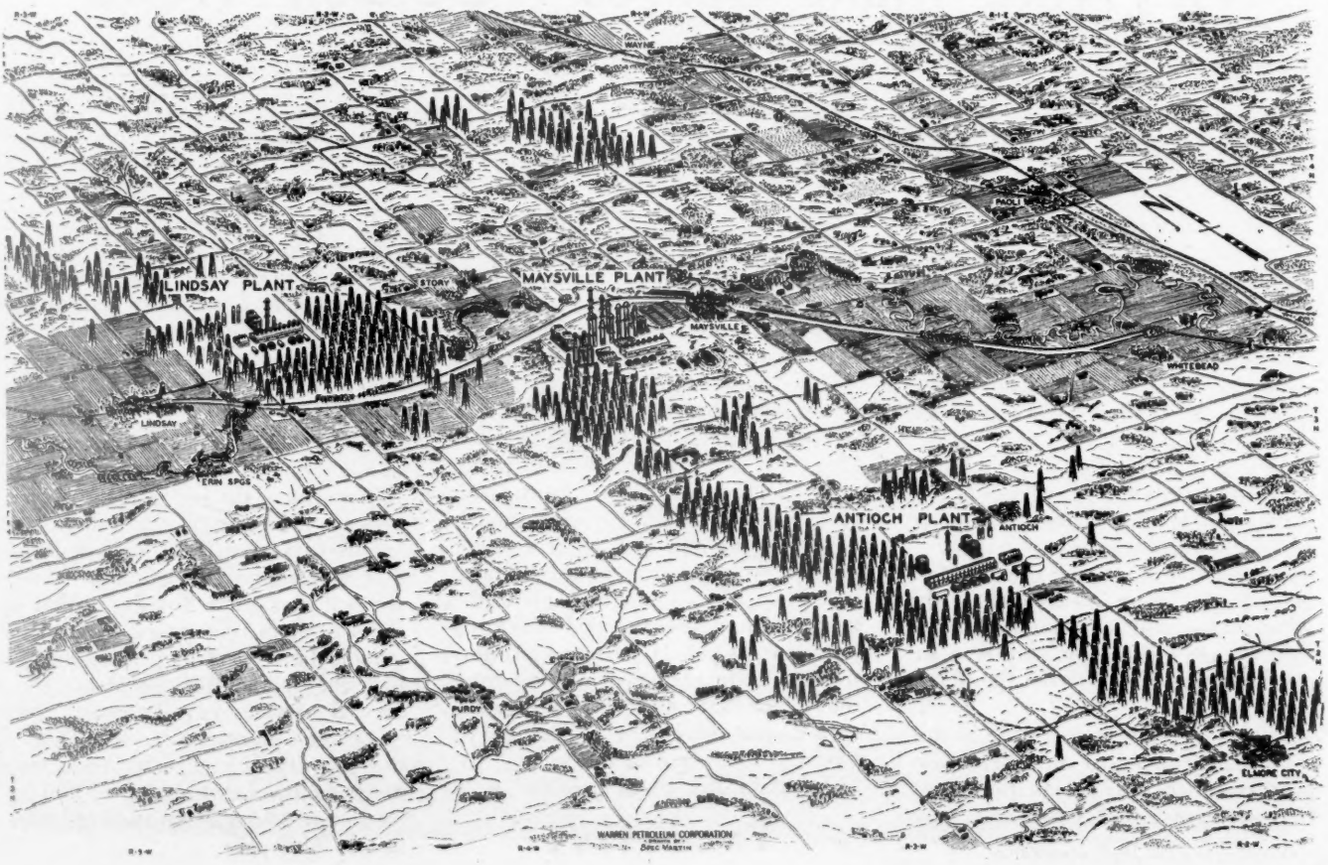
Provision of the 400,000 gal of water needed daily proved a problem. In the preliminary survey it was found that at peak summer loads the flow in the nearby Washita River was too scanty to meet the demand; furthermore, water from the river must be treated heavily, an additional expense. The near-surface Red Beds do not contain enough water to meet the needs of three plants but by following them 17 miles away where they have dropped to much lower levels, four wells in a radius of a mile yield 425,000 gal per day to supply all three of the new plants.

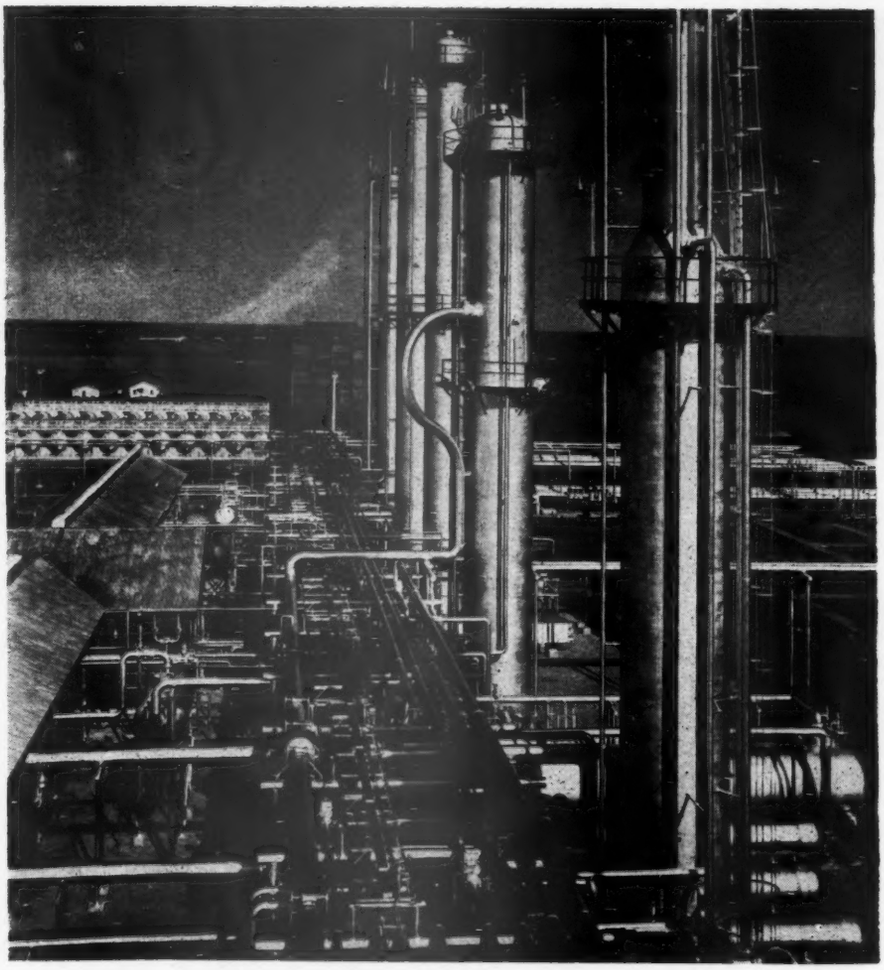
This relative scarcity of water, and the production cost of that which is supplied, induced the designers to dispense with as much water as possible in operating the plant. Instead of steam for heating reboilers and stills, etc., this heat is supplied by four vertical heaters, as shown in the accompanying photographs. Two of these heaters heat the rich oil to the plant stills, are rated at 33,950,000 Btu per hour each. By means of the other units, continuously circulated heating oil supplies all stripping—reboiler—heat needed for the various fractionators and rectifying columns used in finishing the various products. These larger heaters are rated at 41,500,000 Btu per hour each. Coolers for engine jacket water are radiator type air coolers; the same type coolers as the still and debutanizer primary condensers, which reduces to a minimum the water loss by evaporation on these hotter vapor streams.

In these days of excessive construction costs, all efforts are directed to reduction of costs without detracting from efficiencies. For this purpose and to increase flexibility of operations parallel units for distillation, and for rich oil demethanizing were built, thus reducing tower diameters.

The Maysville unit, largest of the three and the only complete gasoline recovery plant, includes absorbed and compressor units similar to those in the other two plants. It also employs

An artist's conception of the Golden Trend area showing the relation of the three major units of the Maysville project to the surrounding oil fields. The extent of the producing area and complexity of operations may be more easily visualized by this drawing.





A portion of the distillation and fractionation equipment is at right; at left is part of the long pump building. Left to right are: Deethanizer, depropanizer, debutanizer, still, demethanizer for rich oil (propane refrigeration).

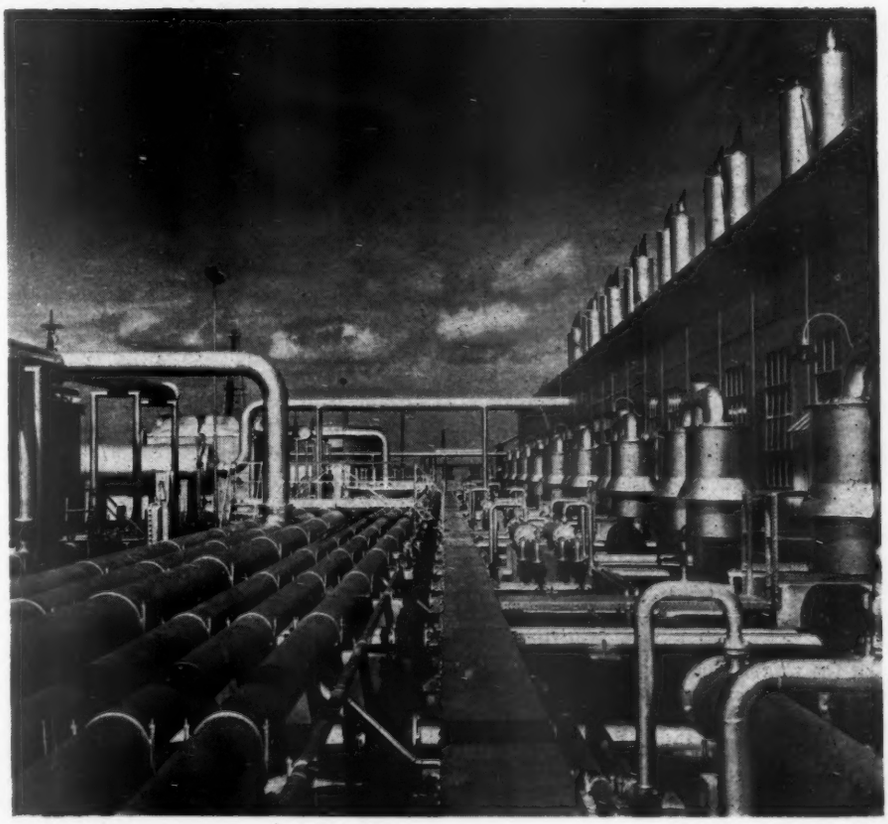
the stills, fractionators, and rectification units required for the production of natural gasoline, LPG and other products. Three absorbers in the three plants supply the rich "fat" oil for further processing.

Two 600 hp Clark compressors handle nearly 5,000,000 cu ft of gas from about 5 in. vacuum through three stages to 760 psig. About 9,000,000 cu ft of 'separator' gas is handled daily by two 800 hp compressor units through only two stages, the gas being delivered to suction at about 40 psig. The Maysville absorber operates at the delivered 760 psig, is 4½ ft diam, has 30 trays, and handles 30,000,000 cu ft of gas per day.

The rich oil from this absorber is mixed with the rich oil from the Lindsay and Antioch absorbers as mentioned below. The combined stream is flashed into two 7 ft by 30 ft surge tanks at 285 psig; this flashed rich oil passes to the top of the stripping sections of the two parallel demethanizers at 250 psig and at 80-90 F. These demethanizers are 7 ft diam in the stripping section that contains 20 trays. The absorber sections are 4½ ft diam and have 30 trays. Heat for the stripping sections is obtained by exchange between the hot lean oil just out of the still and a stream of rich oil drawn from the base of the stripper section, which is returned to the demethanizer tower. Any more heat required is supplied by a shell-and-tube exchanger heated by a stream from the vertical furnace-heated circulating oil. Oil level in the demethanizer is controlled automatically and the stream drawn off is flashed directly into the parallel flash tanks as mentioned above. From these tanks the rich oil passes into the direct-fired furnaces where its temperature rises from about 380 F to 525 F; it goes to two parallel-operated stills at 90 psig, the stills, being 8 ft diam and containing 30 trays.

Stripping arrangements for the stills are somewhat unique. The overhead light hydrocarbon vapors from the flash tanks are preheated by hot lean oil from the base of the stills, and are admitted to the stills as primary stripper material a few trays below the inlet for the rich oil. As a final stripping action preheated deethanizer overhead

These gas headers feed the gas to the compressors in the compressor building at the right near Lindsay.



vapors, at 500 F, are fed to the stills below No. 1 tray.

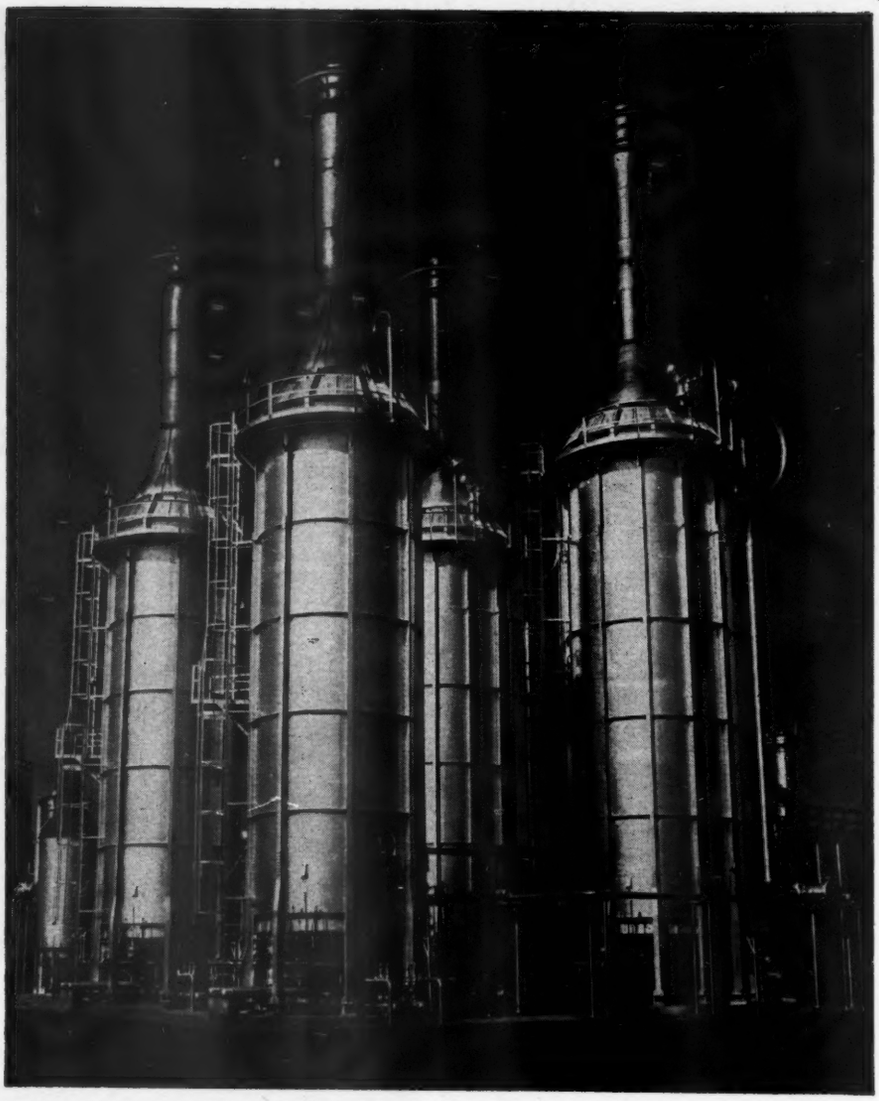
Two-stage condensing is employed for the still overhead vapors. They enter first air-cooled, fin-type coolers to condense the heaviest products; the remaining vapors are led to coils submerged in the base of the induced-draft water cooling towers where the remainder of the raw product is recovered as condensate. Both condensates go to the raw "make tank," operated at 75 psig.

Vapors from these make tanks are compressed and blended in coils with the liquid stream from the make tanks and the blend sent to two parallel surge tanks. By dehydrating the whole of the raw gasoline with solid type dessicant, the deethanizer overhead vapors can be refrigerated; this permits production of the propane stream from the plant without further dehydration. The product from the deethanizer base is fed directly to the depropanizer; this sends commercial propane overhead as vapor, which is condensed. The base depropanized product is passed to the debutanizer, the operating conditions of which are varied to meet the demands for varying vapor pressures—that is, varying butane content—of the natural gasoline at different times. Reflux for this debutanizer is condensed entirely by fin-type air coolers; the final butane product is cooled in water-submerged coils in the water cooling tower already mentioned.

The finished, cooled gasoline is treated to eliminate any corrosiveness and then goes to pressure storage. This "farm includes pressure storage for propane, butane, and natural gasoline, totaling 1,900,000 gal. Centrifugal pumps driven by electric motors deliver the products to a tank car loading rack that accommodates 38 cars simultaneously, two miles away from the plant. Plunger type pipe line pumps deliver gasoline to two pipe lines.

Antioch Plant

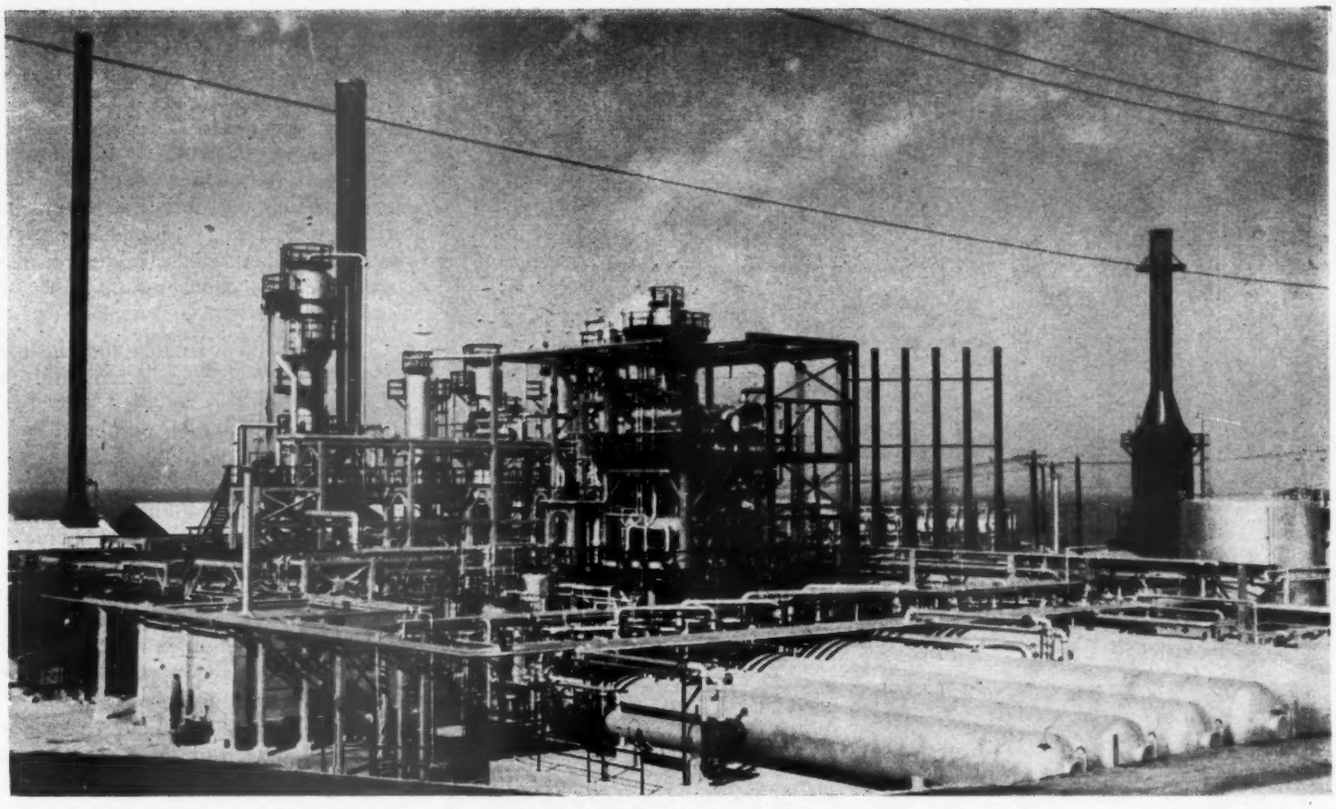
At the Antioch plant, serving that part of the area south of the Maysville plant, 13 gas-engine driven compressors, of 8400 hp handle a design volume of 31,000,000 cu ft of separator gas from 5 in. vacuum through three compression stages up to 760 psig. A 5-ft diam absorber with 30 trays and designed for 800 psig working pressure on 40,000,000 cu ft of gas extracts the hydrocarbons from the gas. This gas is then dehydrated, and that part of the stream intended for reinjection is compressed to 2400 psig for return to formation. Three engines of a total of 2000 hp do this compression job. Between the time this plant was put into operation and the completion of the Maysville unit, two temporary fractionators were installed at Antioch to rectify the gasoline. These towers were removed after completion of the main finishing units at Maysville. These fractionators also handled the raw product from the Lindsay unit, which was also completed before Maysville was on stream. The Lindsay plant, started early in the spring of 1949, uses 10 angle-type compressors, 800-hp gas engine driven, to handle 27,000,000 cu ft of gas daily, boosting it from 5 in. vacuum to 760 psig through these stages. One of these units, however, receives 9,000,000 cu ft of gas from separators at 200 psig initial pressure, and in a single stage brings it to the standard delivery pressure. The entire combined gas stream goes to the 5-ft diam absorber, having 30 trays also, designed for 40,000,000 cu ft daily capacity. The stripped gas is dehydrated by solid dessicant and is sold to a gas utility company. These dehydrators are regenerated—dried—by a stream of residue gas that is heated in a direct-fired vertical coil furnace with a rated capacity of 3,050,000 Btu per hour. Streams of rich oil from both Lindsay and Antioch are pumped to the Maysville plant for stripping out the raw products, as noted above. * * *



These direct-fired oil heaters are used instead of the conventional steam boilers for generating plant heat and processing temperatures: Are rated at 30 million Btu per hour.

First Gas Well Reached 27 Ft

Natural gas was first produced commercially in 1821 at Fredonia, New York. The well from which the gas came was situated near a bubbling spring and the well was drilled to a depth of 27 ft. The gas supplied some 30 burners and was transported through a wooden pipe line. To which we can only add: It must have given someone some terrific headaches trying to keep all the leaks plugged.—*Huber News.*



Union Oil Company's new Duo-Sol plant completed recently at the Oleum Refinery with a capacity of 6000 bbl a day. It produces a paraffinic base for Triton motor oil.

Union Oil Two-Solvent Lube Unit Operating

J. C. ALBRIGHT

In order to produce a greater quantity of superior products for its customers in the western states, Union Oil Company, of California has spent several million dollars recently for plant improvements and new processes. Among the new processes installed at the refinery in Oleum, California, is the 6000-bbl capacity Max B. Miller, Inc., Duo-Sol plant. This unit processes a charging stock produced under vacuum from selected San Joaquin Valley waxy crudes to extract all of the undesirable asphalt and naphthenic components so that the paraffinic constituents remain to manufacture Triton motor oils.

This process is accomplished with two solvents, propane and "Selecto," a mixture of phenol and cresols, and as the two solvents have widely different specific gravities little or no solubility is encountered between the two. The naphthenic and asphaltic components of an oil are readily soluble in the Selecto while the paraffinic constituents are readily soluble in propane, therefore, a sharp cut can be made between the undesirable and the desirable paraffinic fractions.

The feed flows by gravity from storage to the suction of the long residuum pumps with a discharge volume controlled by flow recorder controllers to the first part of the process, which is a crude to solvent mixer where the long residuum is intimately mixed with a raffinate phase from one of the extractors, and an extract phase from another. The flow of the raffinate phase follows through the seven extractors in series, counter-current to the extract phase, also in series. These extractors are long horizontal vessels containing two baffle plates extending almost the full length of the vessels where the extraction of the asphaltic from the paraffinic fractions occurs. The much heavier extract separates from the propane dissolved paraffinic raffinate and settles rapidly to the bottom of the vessels where it is removed by pumps to follow through to the next vessel. To obtain the initial mix of the charge and the solvent phases, the selecto extract is pumped from the bottom of No. 4 extractor and the propane raffinate removed from the top of No. 2 extractor. These streams combine with the crude charge in the mixer and are cooled in a salt water exchanger to 100 F, to re-enter extractor No. 3 at the inlet nozzle in the center of the vessel head. Extract fol-

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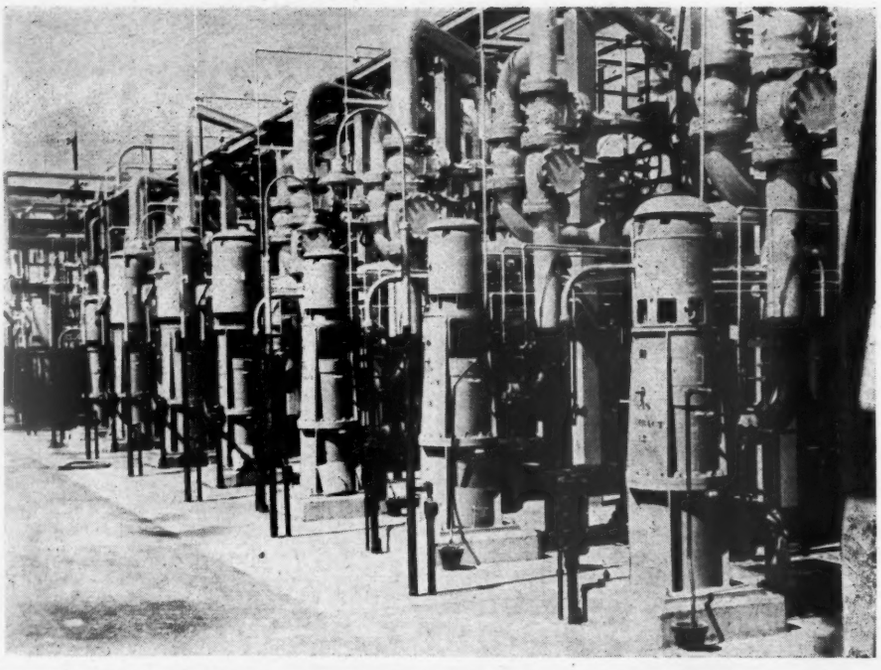
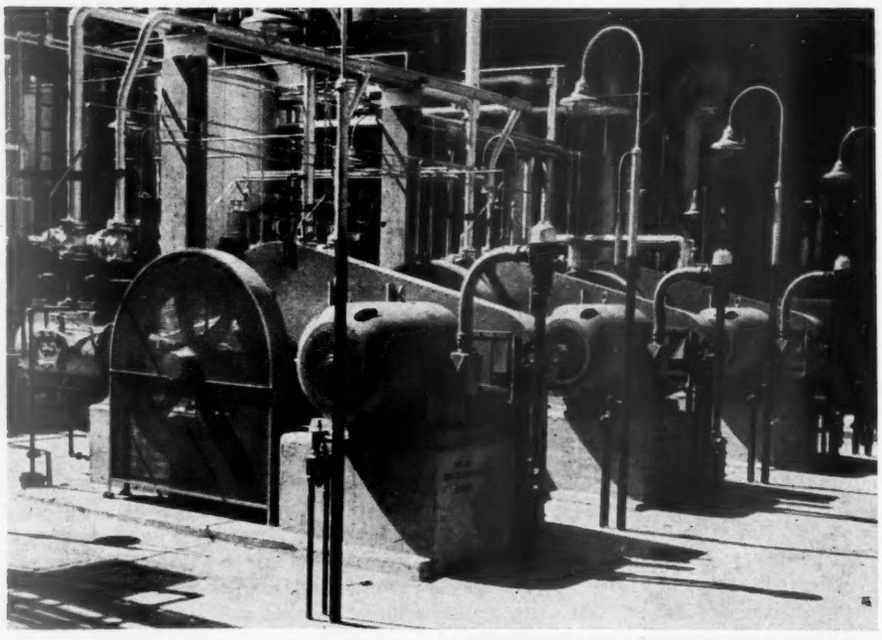
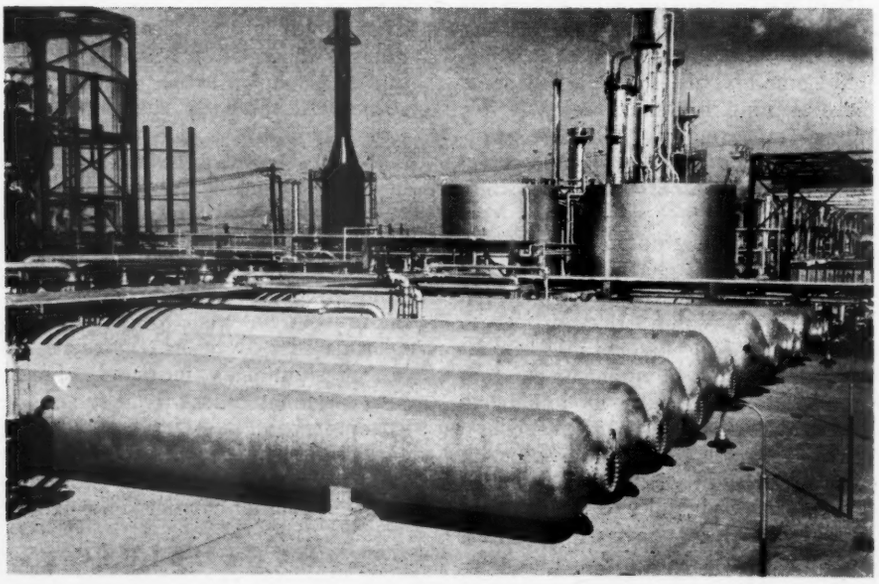




Top, contactor transfer pumps that handle the extract phase of the Duo-Sol plant.

Motor-driven compressors that handle the propane extracted from the raffinate and the extract in the Duo-Sol plant.



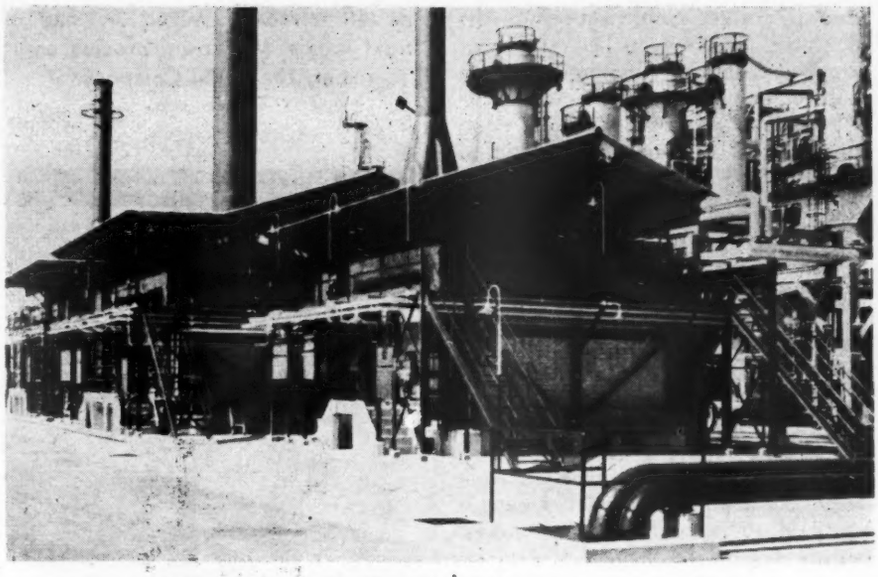
Right, horizontal extractors.

lows back in its operating path to extractor No. 2 and No. 1, from which it is pumped to recovery. The propane rising from the mass of material, flows progressively from the top outlet of each vessel until it is removed from No. 7 to flow to recovery. A pressure gradient is maintained on the vessels, starting at about 350 psig. with the pressure held higher on extractor No. 1 than upon extractor No. 7.

The raffinate layer leaving the top of extractor No. 7 has a temperature of 100 F, and is divided into two streams, one of which regulated by a flow recorder controller flows as reflux to the top tray of the propane evaporator and amounts roughly to about 30 per cent of the total raffinate. The 70 per cent of the stream enters the tube side of a preheater where temperatures of around 400 F are picked up by hot selecto released from the selecto recovery phase of the system. From the preheater, the 400 F stream enters the propane evaporator in a conical section four trays below the top of the column. At the temperature of around 400 F under a pressure of 215 psig, the propane evaporates and flows upward through the top four bubble plates where any of the selecto in vapor state is scrubbed out of the stream by the 100 F propane raffinate reflux pouring down over the trays. The entire quantity of raffinate, plus the remaining propane and the selecto are withdrawn from the evaporator at a trap-out and flows through a reboiler where heat is interchanged with selecto vapors from the selecto evaporator. The commodity, now at 500 F and at 215 psig re-enters the propane evaporator below the trap-out tray so that most of the remaining propane is removed; the raffinate and the accompanying selecto

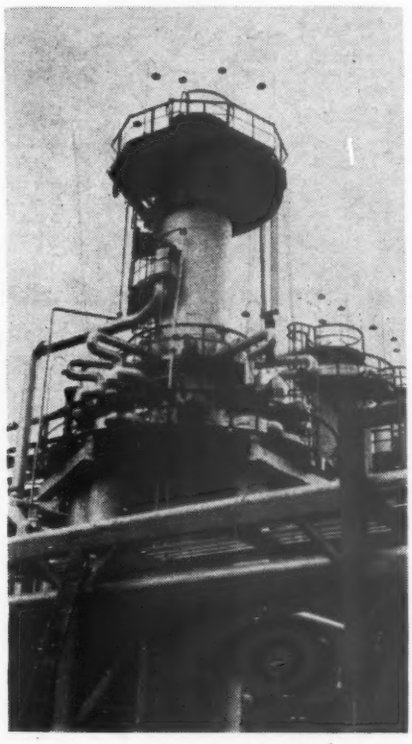
are released from the base of the column through a liquid level controller.

As it is more difficult to remove the selecto from the raffinate than stripping out the propane, some of the former is still in the raffinate which is directed to the selecto evaporator with the pressure dropped abruptly from 215 psig to 70 psig to flash out all of the selecto possible under these conditions. Raffinate flows from the base of the selecto evaporator from which it is pumped to a fired heater to increase the temperature to 600 F. From the heater transfer line, the raffinate divides into two streams, one being returned to the selecto evaporator as a source of heat for this column while the remainder is piped to the selecto stripper at a rate controlled by a liquid level instrument on the base of the selecto evaporator. From this column, the raffinate passes through two additional phases to remove the last vestige of selecto; the vacuum stripper with 12 trays and operated at 80 mm of mercury pressure, absolute with the introduction of superheated steam. This phase cleans the raffinate of selecto while the raffinate at about 560 F, is passed through a steam generator to produce operating steam. It flows from this section to salt water coolers to be reduced in temperature from about 390 to 175 to storage.



Heaters in Duo-Sol plant, which supply processing temperature for stripping operations.

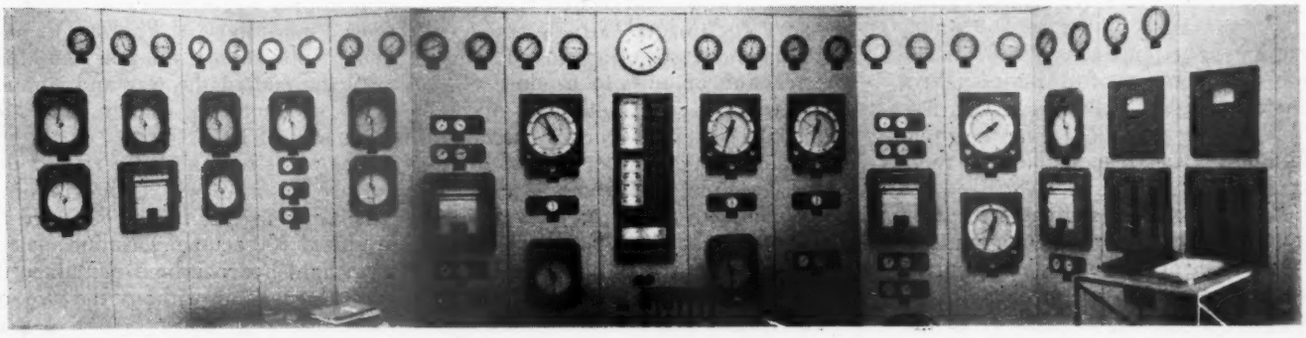
Extract column with six exchangers arranged so one may be cut out of service and cleaned without disturbing plant.



The extract leaves the bottom of extractor No. 1 at 100 F, with approximately 8 per cent of the stream piped to the propane evaporator as a partial reflux. The 92 per cent is raised in temperature by exchange heat from 100 F to above 200 F to flow through a pre-heater for a temperature of around 400 F. It enters a propane evaporator with a pressure of 215 psig where most of the propane is evaporated. The vapors flow upwards against a reflux of 100 F propane to prevent selecto from leaving the column at the overhead. Extract and selecto are further separated by heating with a direct fired furnace to 600 F so that part of the hot stream may enter the selecto evaporator below the bottom tray for column process temperature. A step down stripper is operated where the pressure is abruptly reduced to 70 psig so that most of the selecto is removed from the mixture. From the base of this column, the extract is piped to a vacuum stripper, operated at 80 mm of mercury absolute with a steam jet ejector. The last trace of selecto is removed from the extract in this operation, but to take advantage of the sensible heat, the stream is passed through a steam generator to bring the temperature down to about 380 F and is followed by final salt water cooling to 200 F. The extract is then pumped to storage from which it is removed for manufacturing products, including asphalts and the like.

Most of the propane removed from the raffinate and the extract is recov-

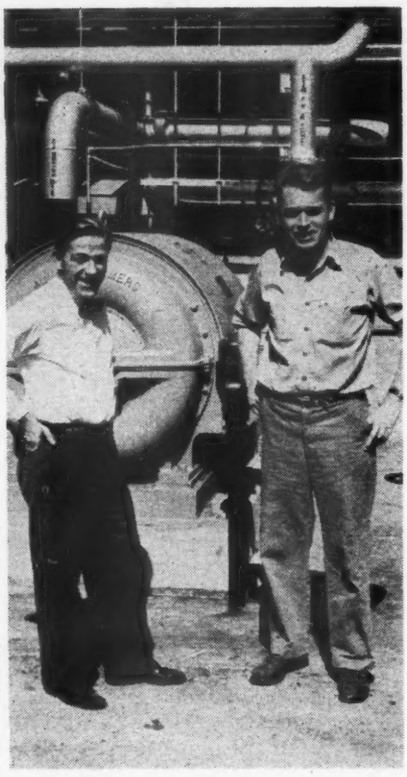
Control panels in Duo-Sol plant. This is a composite of three photographs to show the extent of the panel.



ered by direct condensation of the overhead vapors from the two propane evaporators. Vaporized propane from other phases of the operation is collected at various points and combined for scrubbing with caustic to remove H_2S. The vapors are compressed to 215 psig and flow through a shell and tube water cooled condenser operated at plant water temperature. Undesirable fractions in the propane, such as ethane and methane, are removed by means of a purger, which is a fractionating column with a chiller inserted in the top of the tower supplemented by a small stream of liquid propane drawn from propane storage. The refrigeration condenses desirable propane, but as the temperature is controlled, the lower boiling fractions pass overhead into the refinery fuel system.

Most of the selecto removed from the extract is contained in the overhead from the selecto evaporator and these vapors, free of water, are employed as a source of heat in the shell sides of reboilers for heating the raffinate and propane for recovery in that phase of the plant operation. As many points are in the plant where selecto is encountered, several operations are necessary to isolate the selecto from the other materials and

At left is Max B. Miller, Jr., and at right Robert M. Brown, process engineer, Union Oil Company of California.



the commodities so that it can be brought back to a pure state for reuse. After the operations have been completed to a certain point, the selecto at 160 F divides into two streams, one being used as reflux in the vacuum stripper, and the other flowing through the tube side of the propane charge heater. The selecto is cooled to 138 F while heating the propane charge to 115 F, and finally is reduced in temperature to 110 F to flow to the selecto storage tanks.

Characteristics of the feed stock and products are shown below:

	Charge	Raffinates	Extract
Yield, volume per cent	100	37.3	62.7
Gravity	13.8	30.5	5.4
Sp. Gr.	0.974	0.874	1.033
Newest Solvent Plant—			
Vis, SSU at 210 F	400		61
VGC	0.897		0.790
Flash point F	490		.....
Color, ASTM	.....		4.5
Conrad Carb Res.	10		.....
Material Balance—	B/SD		LB/Hr
Charge			
Residuum feed	6,000		85,070
Selecto	22,200		340,290
Propane	34,500		255,220
Raffinate Layer			
Raffinate	2,240		28,450
Selecto	1,860		28,450
Propane	22,050		163,090
Extract Layer			
Extract	3,760		28,450
Selecto	20,340		311,840
Propane	12,450		92,130

* * *

Pontiac Refinery and Chicago Corporation Schedule Chemical Plant at Corpus Christi

Plans for a $15,000,000 chemical and refining industry in the Corpus Christi, Texas area have been announced by Edwin Singer, president of Pontiac Refining Corporation, and C. R. Williams, vice president of The Chicago Corporation.

The two companies were the successful bidders on the Great Southern 100-octane refinery recently offered for sale by General Services Administration as a government surplus war plant.

It was stated that acquisition of this plant, on a bid of $756,000, sparked the decision to proceed immediately with the initial phases of a program that has been under consideration by the two companies for several years.

Singer and Williams said a combination of circumstances "favorable for development of a major petrochemical industry in Corpus Christi, plus a ready made plant site on which to build" was responsible for their decision.

"The plant site is situated on deep water," their announcement continued "which insures economical marine transportation of our product to the Eastern Seaboard, as well as to the entire Gulf Coast and Mississippi Valley by inland waterway. We control ample supplies of raw materials and fuel in our immediate area and will be able to effect a highly efficient integration of chemical manufacturing with our existing and planned refining operation.

"A twenty-year supply of light petroleum hydrocarbons, which will be the basic raw materials for the chemical development, is contained in the natural gas reserves of the Chicago Corporation, and additional reserves are steadily being developed in this area.

"All of these factors convince us that we are in a favorable position to develop a large and stable chemical industry for Corpus Christi."

Plans and engineering work for the construction of units to produce 60,000,000 lb per year of ethylene glycol, 10,000,000 lb per year of ethylene oxide, and 5000 bbl per day of high grade gasoline are already substantially complete and need only to be revised to fit the Great Southern facilities before construction will begin on these initial units, it was stated.

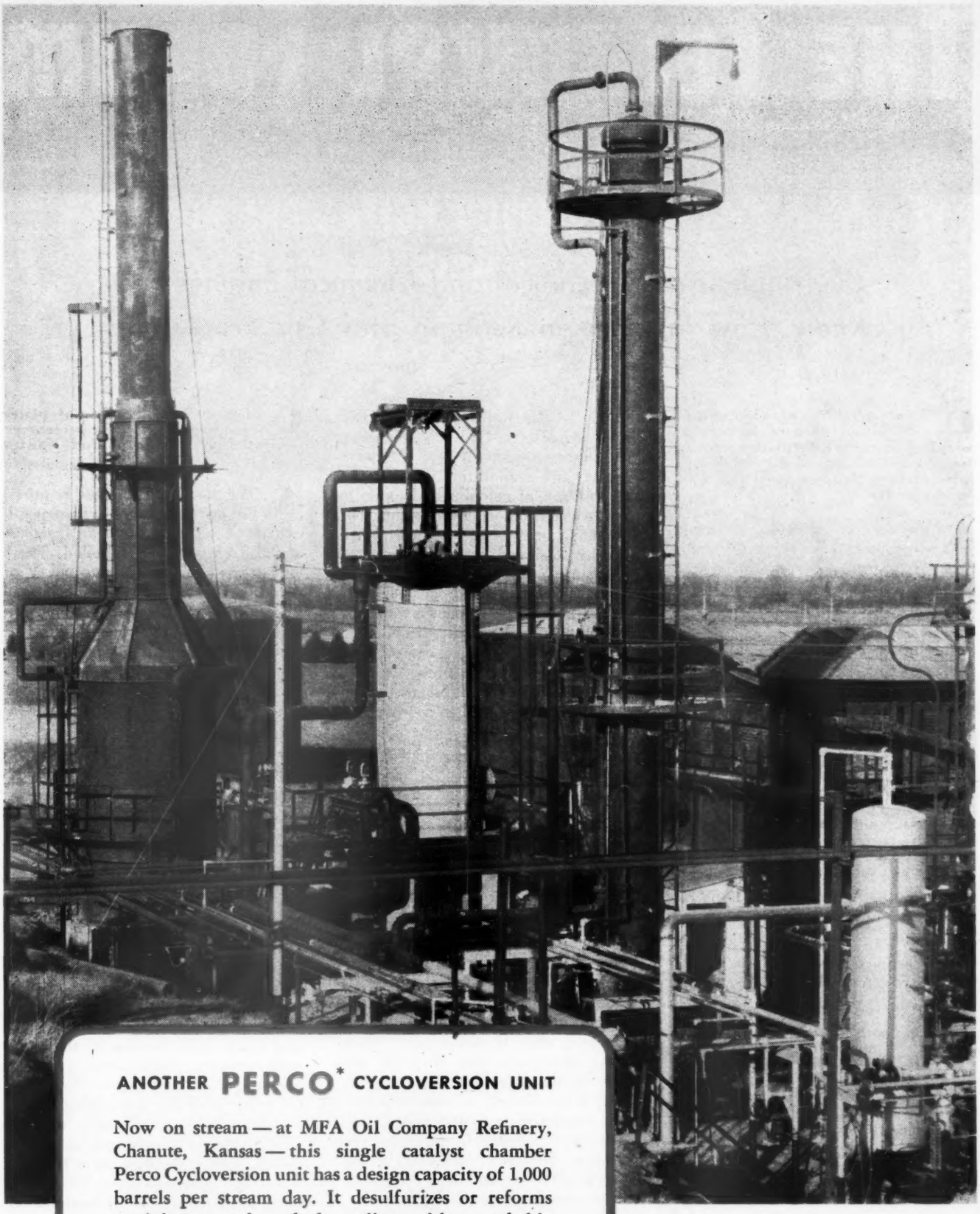
The largest and best known use for ethylene glycol is as a permanent type anti-freeze in automobile radiators. Ethylene oxide is used as a grain fumigant and as a raw material for the manufacture of other chemical products, including plastics.

Other chemical products on which preliminary planning has been started are: Butadiene, ammonia, ammonium sulphate, ethylene dichloride, butyl-alcohol, polyethylene, and a super octane blending agent, the nature of which was not disclosed.

The Great Southern refinery was built by the government as a defense plant during the early years of the war on a site adjacent to the Pontiac Refinery. It was operated for the government by Great Southern Corporation, a subsidiary of Pontiac, to produce 100-octane aviation gasoline until the end of the war and components of synthetic rubber until the latter part of 1947.

The plant represented a radical departure from then existing refining techniques in that it was designed to produce 100-octane gasoline solely from light hydrocarbons contained in natural gas and without the use of crude oil.

* * *



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Q What quantities of what chemicals should be used to combat corrosion in a crude distillation unit, in the presence of typical percentages of (a) Hydrogen Sulphide; and (b) salts, NaCl plus $MgCl_2$?

A For nearly all cases in crude distillation equipment the addition of anhydrous ammonia gas through a rotameter to the transfer line or to the fractionation tower, is the cheapest and most effective corrosion inhibitor. The quantity to be used will vary with the amount of acid released in the distilling operation, and control can be effected by checking the pH of the water at the gas and water separator. For oils releasing very large amounts of H_2S corrosion of tubes and evaporators may require the addition of calcium hydroxide to the raw crude entering the heater. The amount to be used can be determined only by trial and error, because the temperatures employed may be the controlling factor, and the salability of the fuel oil containing calcium sulphide may be equally important. Wherever possible, it is desirable to use enough chrome in tubes, evaporators and any after equipment operating above 600 F so that corrosion is avoided.

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where c is minimum number of plates.

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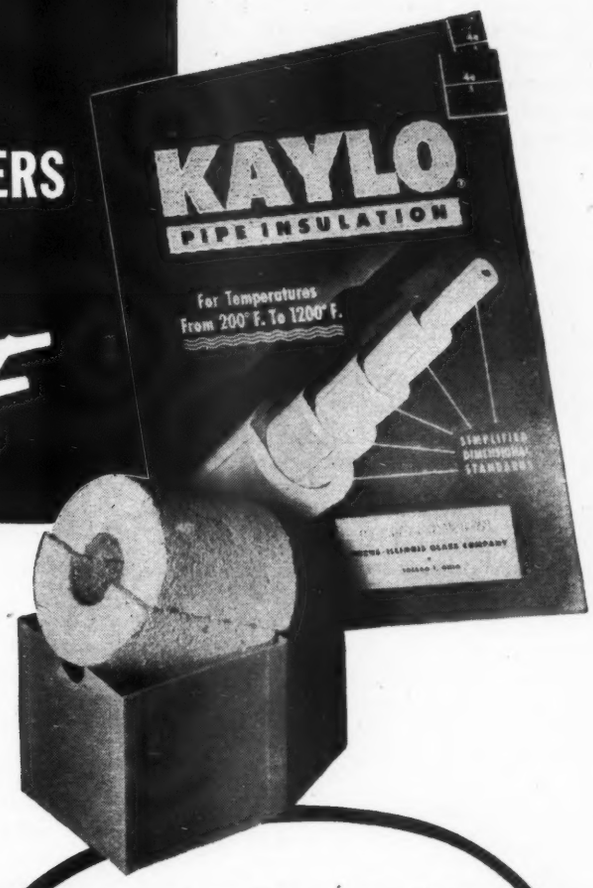

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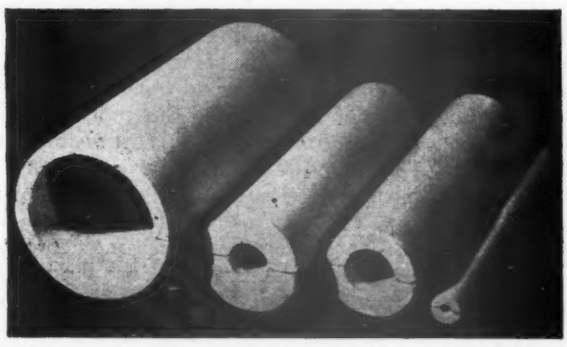

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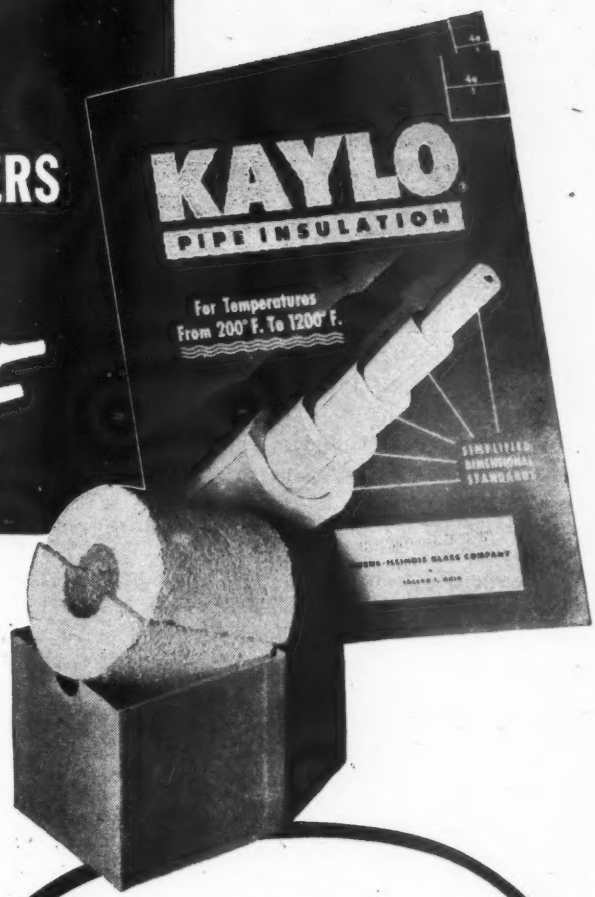

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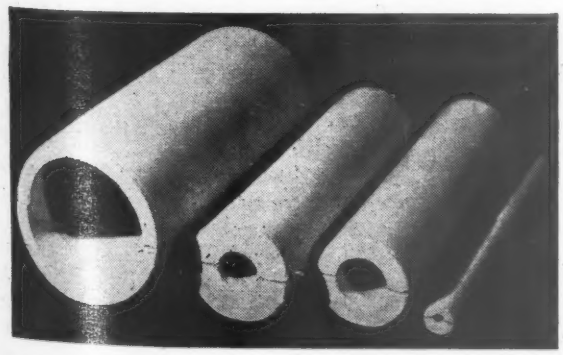

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$$(iP)_b = \frac{(iP + nP)_t\,(\alpha_{iP/nP})^{c+1}}{(nP/iP)_b + (\alpha_{iP/nP})^{c+1}} \quad \ldots\ldots\ldots\ldots \text{(b)}$$

$$(nB)_b = \frac{(iB + nB)_b\,(\alpha_{iB/nB})^{c+1}}{(iB/nB)_t + (\alpha_{iB/nB})^{c+1}} \quad \ldots\ldots\ldots\ldots \text{(c)}$$

$$(iP)_t\,(nB)_b = (iP)_b\,(nB)_t/(\alpha_{nB/iP})^{c+1} \quad \ldots \text{(d)}$$

where the b and t subscripts indicate mols of component in the reboiler outlet liquid and top tray vapor respectively. Here is an example:

A debutanizer, operating at 100 psig with totally condensing top product, is to separate between butanes and pentanes; a 1 per cent inclusion of butanes in the bottoms and pentanes in the tops is to be allowed. Basis: 100 mols of feed. A first assumption of tops and bottoms composition is as follows:

	Feed	Tops	Bottoms
Prop.	10.0	10.0	—
i-B	10.0	9.9	0.1
n-B	20.0	19.5	0.5 (0.6)
i-P	10.0	0.3	9.7
n-P	20.0	0.1 (0.4)	19.9
Hex. plus	30.0	—	30.0
	100.0	39.8	60.2

The top tray and reboiler outlet temperatures are obtained by a dewpoint calculation on the tops and a bubble-point on the bottoms (not shown). They are 133 and 285 deg respectively. Relative volatilities (ratio of K's) are figured at these temperatures and the average between 133 and 285 deg obtained for each pair of components:

	Average Relative Volatilities
nB/iP	1.97
iB/nB	1.249
iP/nP	1.174

Assume minimum plates, $c = 9.5$. Substituting in eq. (b) and (c):

$$(iP)_t = \frac{(0.4)\,(1.174)^{10.5}}{(19.9/9.7) + (1.174)^{10.5}} = 0.29$$

$$(nB)_b = \frac{(0.6)\,(1.249)^{10.5}}{(9.9/19.5) + (1.249)^{10.5}} = 0.57$$

Substituting the above results into eq. (d):

$$(0.29)\,(0.57) = (9.7)\,(19.5)/(1.97)^{c+1}, \text{ or } c = 9.4$$

This checks with the assumed value (9.5); therefore a minimum of 9.4 theoretical plates will be required for this separation. Since total pentanes and butanes in the tops and bottoms are 0.4 and 0.6 respectively, the distributed iB and nP are obtained by difference. The tops and bottoms composition will then be:

	Tops	Bottoms
Prop.	10.00	—
i-B	9.97	0.03 (0.6)
n-B	19.43	0.57
i-P	0.29 (0.4)	9.71
n-P	0.11	19.89
Hex. plus	—	30.00
	39.80	60.20

Debutanizer plate efficiencies run in the order of 75 to 90 per cent. Assuming 80 per cent, actual minimum number of trays required will be $9.4/.80 = 11.7$. Usual practice in the design of such towers is to supply two to three times the minimum number of trays except where an extremely sharp cut would require an enormously tall tower. The above debutanizer should be equipped with about 30 trays.

The calculation of number of plates required at various reflux rates is too involved to be given here. We suggest the reader refer to an article by C. G. Kirkbride[2] where several relatively simple methods are given for the solution of this type of problem.

In connection with the above problem, it should be noted that although the calculated proportions of iso and normal compounds in the two cuts are strictly correct at minimum plates (total reflux), they are only approximate at other operating conditions.

References

1. Fenske, M. R., Ind. Eng. Chem., *24*, 482 (1932).
2. Kirkbride, C. G., "Process Design Procedure for Multicomponent Fractionators," Pet. Refiner, Sept., 1944.

C. F. Sanderson and Alan S. Glendening.

Q What are the approximate life spans, or attrition rates, of catalysts, (a) pelleted natural catalysts; (b) microspherical catalysts, and (c) "bead" type catalysts?—C. W. Berger.

A On the basis of commercial experience, it is difficult to give a straight forward answer to the question with any certainty. Also it might have been possible to answer the whole question more precisely if the particular use, the desired activity, and particle size for equilibrium catalyst had been specified. For example, in catalytic cracking most refiners have had to discard large quantities of catalyst to maintain the satisfactory activity, particle size, selectivity, or to overcome the effect of contamination or deactivation from an unknown cause. Upsets and mechanical difficulties have also accounted for large catalyst requirements, so that catalyst average use rates have been due to some other cause than normal attrition or normal rate of decline.

It is assumed that the question has been raised with reference to moving or fluidized bed cat cracking operations, and, therefore, the catalysts will be compared in that service. The pelleted natural catalyst (a) and the "bead" or synthetic type catalyst (c) are used in the thermofor catalytic cracking units and the microspherical catalyst (b) in fluid catalytic cracking units.

One of the lowest observed makeup rates on synthetic catalyst (c) is 0.1 per cent inventory. In this case, there was some indication that the attrition was gradually reducing the average diameter of catalyst. It probably would have been necessary to discard fairly large quantities of catalyst and add fresh to raise the average particle size. Using the series equation for average age, 0.1 per cent makeup gives a life span of 2.75 years. Before the operation at 0.1 per cent inventory continued long enough to determine whether or not the particle size might go low enough to result in an increasing amount of catalyst loss out the flue gas vent stack, an alteration in operation required changing the catalyst and raising the makeup rate.

With the natural catalyst (a), the theoretical maximum average age on the basis of some rather extended operation would be about 1.25 years. The particle size or per cent on 8 mesh screen was actually increasing and the life span was about reached before changing conditions required an increased makeup rate. In both of these cases (a) and (c), the activity of the catalyst was maintained approximately constant.

The microspherical catalyst is used in a different system and therefore the attrition rate should not be considered comparable with that in case (a) and (c). The loss of catalyst from commercial fluid catalytic cracking plants seems to be very dependent upon the superficial velocity in the regenerator, although, as reported by Viland,* the distribution of particle size has an influence. Assuming that the superficial velocity in the regenerator was over one foot per second but not over 1.4 ft per second, the theoretical maximum life span would probably be around 400 days. However, the units which have added catalyst at a rate of 0.25 per cent of inventory have usually encountered a decreasingly profitable yield structure or fluidizing troubles when makeup rates have been kept at such a low percentage of inventory.

R. C. Davidson, Roger S. Shute.

*C. K. Viland and James Seth—Oil and Gas Journal, Vol. 47, No. 3, May 20, 1948, p. 186.

Part 7 - Conclusion

Life and Death in an Oil Refinery

P. M. VAN ARSDELL

General Hazards

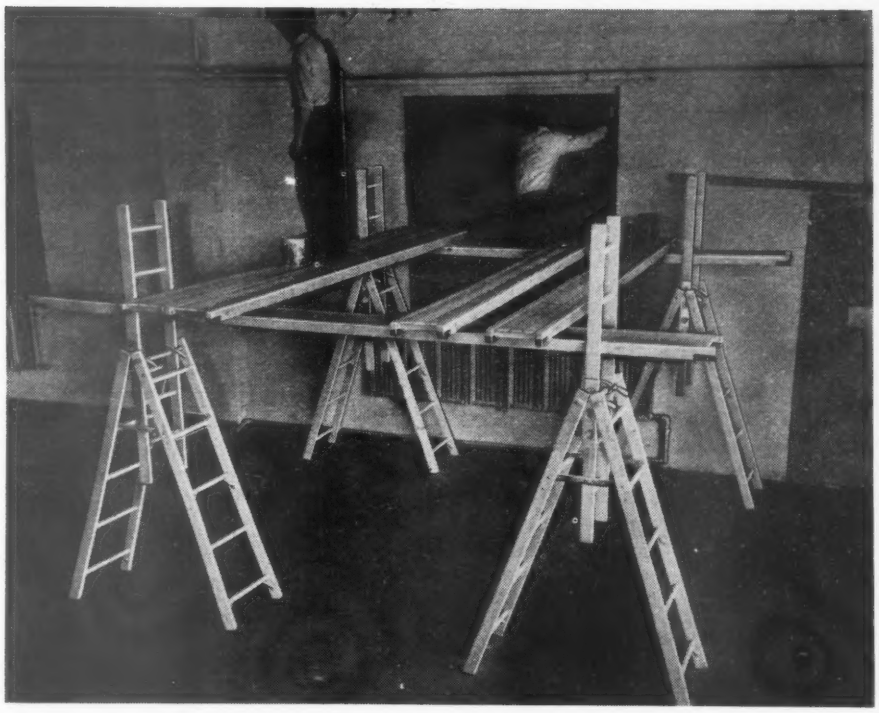
In addition to the specific chemical hazards inherent throughout the refinery causing asphyxiations and other types of physiological reactions, electricity, falling equipment, moving machinery, and other hazards are responsible for many accidents, both fatal and lost time. Electricity ranks high in the causes of refinery fatalities, having caused the death of 21 persons between 1940 and 1947.[18]

Table 12 lists the specific causes of these fatalities and was compiled from the API Reviews of Fatal Accidents in the Petroleum Industry covering the years 1940 to 1947 inclusive.

Electrical injuries are generally of three types, shock, flash or glare injuries to the eyes, and burns.[68]

Shock may occur when an open wire is touched or when a wire falls into an electrolyte such as soil water where a man is standing. If the shock is of sufficient severity there is an apparent suspended animation with the arrest of respiratory effort.

Flash burns of the eyes may be mild or severe; the former giving a persistent after-image for a time and the latter giving several days of burning, itching, and semi-blindness. Unless the exposure is very severe, however, no damage persists.



Adjustable trestles take place of makeshift scaffolds for painting, cleaning and other light-duty work. *Courtesy Patent Scaffolding Company.*

TABLE 12.

Year	Fatalities	How the Fatality occurred.
1947	2	Unauthorized use of equipment.
1947	1	Cable for grounding not attached.
1946	1	Cable makes contact with man giving shock and causing burns on lower back and buttocks. Died from burns received.
1946	1	Unguarded equipment. Man electrocuted on contact with high voltage lines at 8th floor of catalytic cracking unit.
1946	1	Contact made with low voltage (110-v) electric clock circuit.
1945	1	Touches hot wire of 440-v circuit and grounds through pipe.
1944	1	Improper grounding.
1944	1	Electric circuit breaker not shut off.
1943	1	Crane hits 11,500-v line. 2 men holding hook, 1 killed.
1943	1	A man worked bare handed with a 440-v line.
1943	1	Power line (440-v) down. Man makes contact.
1942	1	Circuit not cut in wax refinery feeding unit.
1942	1	Electrocuted by heavy duty portable cord.
1941	1	Contact made with 2300-v line. Power not shut off to continuous treater motor.
1941	1	Bodily contact with 440-v line.
1940	1	Pipefitter makes contact with 2300-v line while shifting pipe.
1940	1	Welder grounds through a damp ground on a switch box.
1940	1	Subforeman grounds welding machines, contacts 440 v.

Electrical burns are classed in three degrees, a first degree burn produces redness and swelling of the skin surface. The skin is dry in appearance and there is early blister formation with considerable pain. A second degree burn is one where the skin surface is broken. A third degree burn involves tissue destruction including perhaps muscle, nerve, and bone.[68]

In all electrical burns there is usually a point of entrance and one of exit from the body. Every electrical burn should be considered a serious one until sufficient time has elapsed to prove differently, as penetration may be deep, and there is no way of determining how extensive. Death has been reported from contact with as low as 46 volts. Usually low voltages cause benign burns, but high voltages give deep burns with great tissue destruction.[68]

First degree burns should be treated as any other burn. The second and third degree burns should have prompt medical attention. When first aid is to be given for shock, the rescuer should see that he is well insulated if the person is to be released from the locked grasp so frequently encountered when a wire has been touched with the palm of the hand. The victim should be given artificial respiration, and a doctor called immediately.

Moving Machinery. Moving equipment of various classes has accounted for 18 fatalities since 1939 in the re-

EXCLUSIVE

finery areas. Equipment of any type in motion is extremely hazardous; not all of it can be guarded adequately. However, from the list given in Table 13 it is quite obvious that several fatal accidents have resulted from carelessness, either on the part of the worker or his supervisors. Ten of the recorded accidents were due to men getting in the path of trucks or railroad equipment, which would seem to indicate that sufficient daily emphasis regarding this type of danger is not impressed upon the workers. Careless attitudes may have been allowed to build up because of familiarity and consistent taking of risks.

Wherever possible all moving machinery should have adequate guards installed. When impossible or impractical, warning signs should be posted throughout the area. The fundamental principles to be observed for guarding refinery equipment are:[44]

"(1) Guards should be substantial and firmly installed.

"(2) The most satisfactory material for all ordinary conditions is metal. Perforated or expanded metal or mesh reinforced with angles or pipe are uniformly used. Wood reinforcements are insecure; of temporary value; add to fire hazards; and should not be used even where corrosive fumes might indicate their value. Fumes that attack metal also attack men's lungs and should be properly eliminated.

"(3) Guards must not interfere with oiling or adjusting machines. Ideally they are to be installed to protect the oiler or adjuster. Guard installations must be made with a view of easy removal and replacement in case of repairs.

"(4) No guard should have sharp edges nor should it constitute a tripping hazard.

"(5) Belt guards, overhead gear, and moving part guards should be strong enough to hold the guarded part should it break.

"(6) Enclosure (complete) of the moving part at least six feet above the floor or working level is a minimum requirement.

"(7) All gears, regardless of size or location should be completely enclosed. Enclosures not only insure safety, but also increase gear life in that dirt is kept out and lubricants are kept in.

"(8) Projecting set screws are extremely hazardous. All types should be firmly submerged. Keys must be sawed and filed so they will be fluid and smooth."[44]

All guarding equipment must be adequate and should be frequently inspected. Mechanical injuries constitute 12 to 15 per cent of all disabling injuries, but they are uniformly more severe, often involving amputations and are more disabling and costly.[44]

TABLE 13.

Year	Fatalities	How fatality occurred
1947	1	Line kick back on microwax line.
1946	1	2-in pipe 4 ft long used to pry on rackerarm of piston to pump that let go throwing pipe and fracturing skull.
1946	1	Crane lines swung and fractured man's skull.
1945	1	Man crushed because of inadequate footing on crane jack.
1945	1	Hit on head by head of air receiver of sand blasting machine.
1945	1	Crushed by coke removal car.
1944	1	Falls on belt conveyor.
1943	1	Crushed under switched railroad tank car.
1943	1	Crushed under tank car during repair operation.
1942	1	Leg caught in cable to winding drum.
1942	1	Falls under tank car while switching.
1942	1	Falls on tracks ahead of switch engine.
1941	1	Oiler killed on striking pump bar of pump in motion.
1941	1	Laborer struck by dump truck bed.
1940	1	Gauger in auto struck by passenger train at crossing.
1940	1	Dump truck crushes man's head when drive shaft breaks.
1939	1	Steps in path of dump truck—crushed to death.

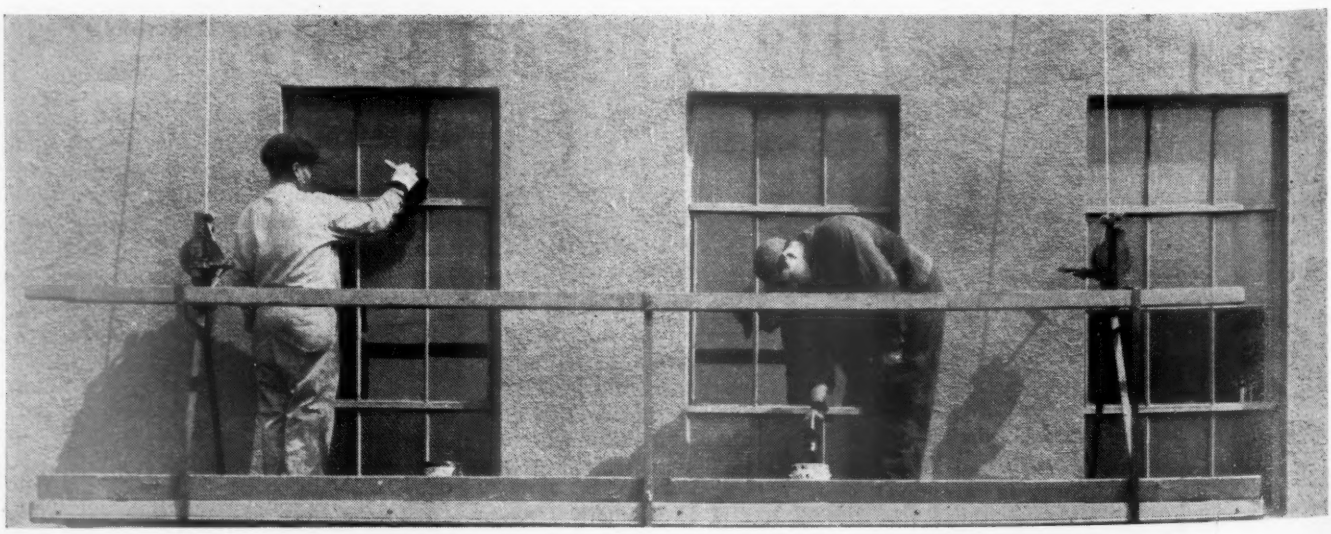
Ladders, Scaffolds, and Falling Equipment. Although it was not the original intention to cover the more common types of accidents, yet their very frequency demands that they receive attention in order that greater vigilance may be applied in reducing their prevalence. As will be noted in most cases, certain precautions if properly taken could have averted the fatality.

Ladder accidents ending in fatalities have amounted to four according to the API reports since 1940. How many lost time accidents were the result of improper use of ladders there is no means of ascertaining. That some persons are more prone to ladder accidents is highly probable as the use of a ladder requires a certain amount of fine muscular coordination both in ascending and particularly in descending. Table 14 shows the fatalities resulting from the use of ladders.

Whenever ladders must be used, the base of the ladder should be tied, or secured by ladder shoes, or held by a

This scaffold eliminates the many dangers involved in the use of rope tackle. Mechanical winch mechanism is locked at all times to prevent slipping or running down. Dangerous hitches are eliminated by use of steel wire rope.

Courtesy Patent Scaffolding Company.



CHEMICO P·A VENTURI SCRUBBER

STOPS ACID FUMES

THESE PHOTOGRAPHS—taken at a pigment plant in Pennsylvania—show how effectively the Chemico P-A (Pease-Anthony) Venturi Scrubber solves the problem of waste sulfuric acid fumes. Instead of pouring from the large stack, the fumes are diverted into the Chemico unit. An infinitesimal residue is emitted through the small stack at the left of the brick chimney. The P-A Venturi Scrubber, in fact, eliminates the need for a large stack.

HERE ARE THE ACTUAL RESULTS OF THIS INSTALLATION:

Sulfuric Acid Mist Loading

INLET TO SCRUBBER	EXIT FROM SCRUBBER	EFFICIENCY
283 mg H_2SO_4 per cu ft	1.06 mg per cu ft	99.6%

The P-A Venturi Scrubber is highly effective and very economical to install and operate. It is recommended for (1) smoke abatement, (2) removal of dust and mist from gases and (3) recovery of valuable metals and chemicals.

This Chemico unit is simple and safe to operate and maintain. Any competent maintenance man can service a P-A Venturi Scrubber. No special skill is needed. Write us concerning your problem.

HOW THE P-A VENTURI SCRUBBER WORKS

Dirty gas, at high velocity, impinges upon and atomizes a curtain of liquid introduced through jets at the throat of the Venturi. Differential velocities of gas and atomized liquid result in collision of mist or dust particles with liquid droplets. The coalescence of mist or agglomeration of dust resulting from this collision makes simple cyclonic separation possible.

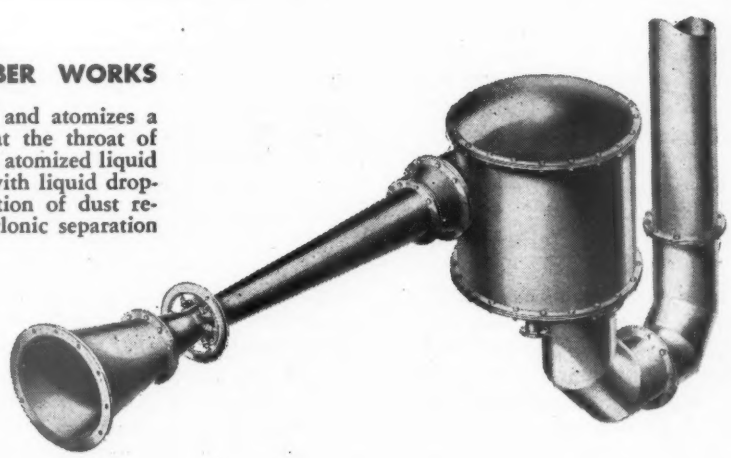


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TABLE 14.

Year	Fatalities	Incident leading to fatality
1947	1	Ladder slides because floor slanted away from wall diagonally allowing one ladder shoe to bear all weight. Ladder was 6 ft from bottom of wall; should have been no more than 3.5 ft.
1947	1	Employe started to descend a 30-ft ladder, missed footing and fell striking back on a valve wheel.
1941	1	Refrigerator engineer falls from a 12-ft ladder striking head on condenser box; spinal cord ruptured.
1940	1	Boiler maker fell 4 ft from ladder to ground landing on his back.

TABLE 15.

Year	Fatalities	Cause of fall
1947	1	Climbed across scaffold, lost balance and fell to platform below.
1946	2	Carpenter and helper fell from scaffold 112 ft above ground. Life belts not worn.
1946	1	Loose board on scaffold caused man to lose balance and fall. No proper inspection.
1945	1	Ropes not retied on scaffold during dismantling.
1944	1	Scaffold accidentally tilted during coke removal operation on tower. Man fell 30 ft to bottom of chamber —no life belt.
1943	1	Scaffolding incomplete—"plank trap" causes 14-ft fall head first to floor of furnace.
1943	1	Steel hangar on one side of scaffold fails allowing a 2-ft drop on one side. Man thrown to floor of power house—no life belt.
1942	1	Rigger loses balance on scaffold, falls to concrete floor—no life belt.
1939	1	Hook of block and tackle became disengaged, man fell 35 ft. Repair job on insulation of atmospheric tower.

fellow worker. The feet of the ladder should be placed on a level parallel to the wall. The angle should be such that the feet of the ladder will be a distance from the wall equal to one-fourth of the ladder length.[7] In addition, the ladders should be inspected regularly to guard against loose rungs, unsteadiness, and deterioration.

Because of the great heights of refinery equipment, scaffolds are necessary for repair and cleaning operations. The use of scaffolds has been the cause of many fatal accidents. Some of the accidents have undoubtedly been due to the faulty selection of workers for the high jobs. It is a well known fact that physiologically and psychologically certain individuals are unsuited for working at great heights. When some persons get off the ground they become dizzy, lose their balance, and fall. Not all of the accidents can be attributed to these reactions—some are just plain carelessness as will be noted from the accompanying Table 15.

As scaffolds are so frequently used around the refinery, frequent inspection of the scaffolds, safety belts, and rope fastenings should be insisted upon. No man should be allowed to ascend the scaffold without his life belt, and the supervisor should insist that all life belts be properly in place and fastened before the job is begun.

Falling equipment has been the cause of 11 deaths since 1938 in the refinery area. Whenever construction and repairs are taking place it must be the rule that all men entering the area wear hard hats properly adjusted. Although this precaution will not prevent all the fatalities due to the weight of falling equipment, it will be most helpful in reducing the lost time injuries. Before hoisting heavy equipment, careful inspection should be made of all hoists, slings, blocks, etc., and the area should be adequately cleared.

As stumbles and falls are particularly hard to control or prevent in any area, being almost as unpredictable as the human, the major industrial precaution is to maintain a high standard of housekeeping. No loose material of any kind should be allowed to remain on the floors, platforms, or stairs. A high rate, nearly 20 per cent, of industrial accidents are caused by falls,[19] and though some are unavoidable from an equipment standpoint, most of them are due to carelessness. Adequate hand rails must be provided on all permanent stairways, catwalks, and platforms, and kept in good repair. Too many serious accidents have resulted from falling from one level to another.

Good housekeeping can entail numerous items around the refinery, ranging from painting and repairing to plumbing, ventilation, lighting, and cleaning. Every one of these items can be important from a life saving standpoint and are definitely advisable as to efficiency of operation. If each of these items is checked by the safety engineer and remedied, the conditions leading to many accidents can be eliminated. Clean floors and walkways will diminish the frequency of falls. All workers should be trained to care for their floor areas making sure that all spills are promptly cleared away as well as all debris and scrap.

Every day new facts are being discovered concerning the psychological adjustment of the worker. New techniques are being tried that are paying off in personal efficiency and safety. New methods of using color have been employed, not only to distinguish various product lines throughout the refinery, but also to provide a wholesome psychological effect by frequent painting of exteriors and interiors with periodic changing of colors.

In considering the overall hygiene of our working population, accidents from operation and equipment have not been the most costly lost time item, but from the same ailment that involves the entire population — the so-called common cold infection. Although certain chemicals in the atmosphere have been shown to increase the susceptibility to respiratory infections, there are others such as propylene glycol and triethylene glycol vapors that seem to have the opposite effect and prevent the spread of infections.[43]

Conclusion

With the rapid expansion of petroleum refining into the chemical industry involving many new processes, products, and techniques, new hazards that should be thoroughly understood automatically present themselves. The use of many different catalysts and chemicals each have their own peculiarities and effects upon equipment and the human being. The first step in accident prevention is to know the hazards and then provide the best means to guard against them.

An unbiased and careful study of general accidents leads to the appalling conclusion that the hazards that caused most of them are the simple and easy ones to guard against. We are always told that accidents just do not happen as such and that every accident is the result of some cause. Naturally one concludes that the propagation of a hazard is pure carelessness on the part of someone. Merely placing the blame after an accident gives very little comfort to the injured ones. Perhaps too much emphasis throughout the years has been placed on accidents and too little on hazards. And since man himself is the greatest potential hazard, thorough and adequate employee training cannot be over emphasized in accident prevention.

Unfortunately safety engineering has not been given the overall proper consideration by top management in many of our large companies, and no consideration has been given by thousands of small companies. It can be reasoned that a qualified and experienced safety engineer is as important as a top executive. Some large companies claim that their direct and indirect costs of accidents runs from $100,000 to $1,000,000 per year. If this is considered in its true light, then accident prevention can be considered a billion dollar a year business on the loss side.

Every college of consequence should have a stiff major course in safety engineering the same as for many other specialized courses. Fortunately this is being recognized now by several universities. To do a good job of

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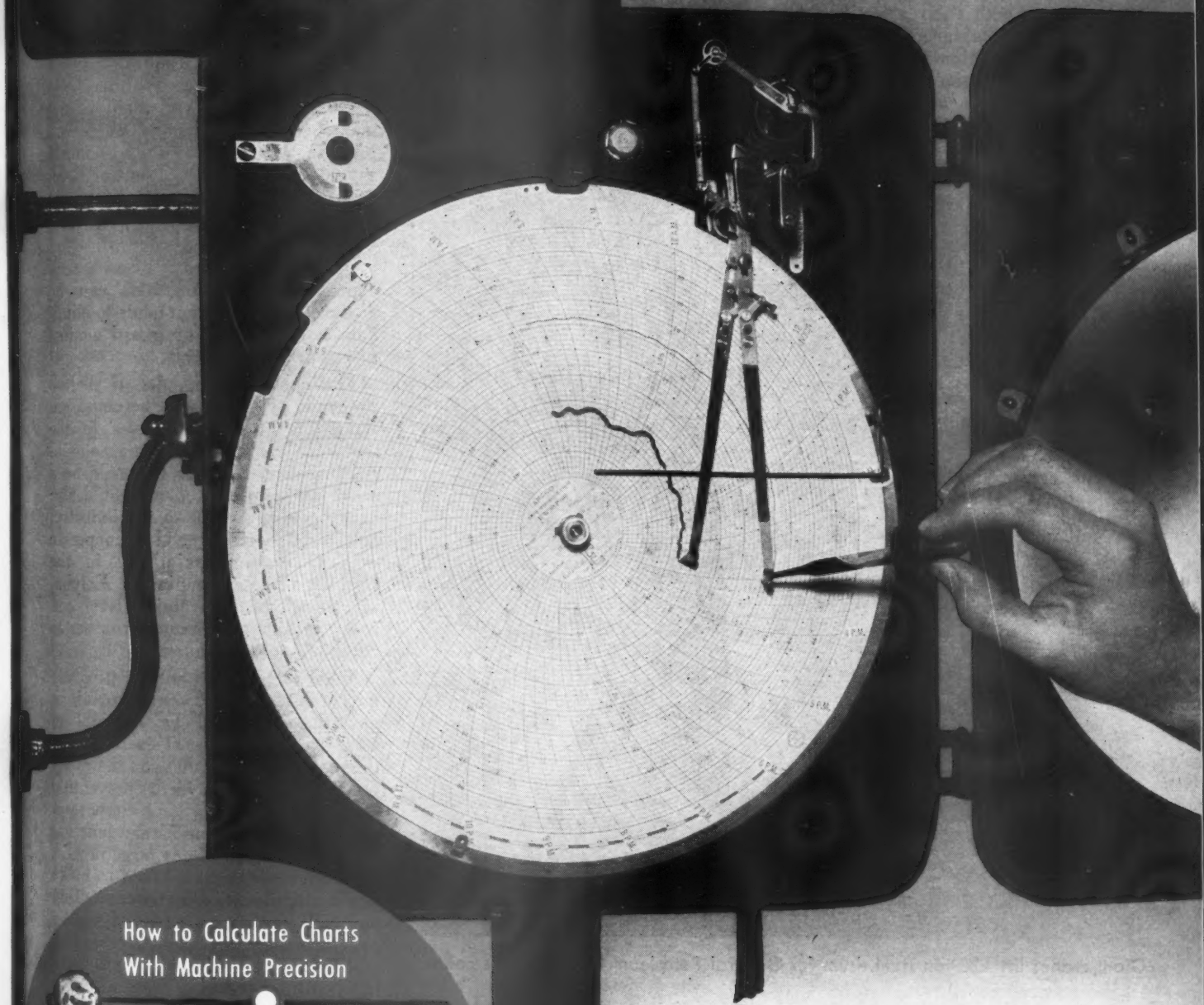

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safety engineering on mechanical equipment it takes a good mechanical engineer, and in the same token on electrical equipment, an electrical engineer, and on chemical processes a chemical engineer. At present, it is difficult to find the safety engineer who has sufficient composite fundamental knowledge in the broad field of safety engineering.

If top managements were as careful and diligent with their selection of qualified safety engineers as they are with their production personnel and adopted and maintained as strict rules and regulations for safety, as they do specifications for their products, accidents eventually would become a rare incident in their respective plants. Speaking generally, it is a pity that many large groups of workers are without the protective influence of a competent safety engineer. Many plants will use any good worker to function as a safety engineer; even though this method is inadequate, it is nevertheless much better than ignoring the importance of such a function. One outstanding result of this study was the profound observation of the lack of good material and data on accidents, especially hazards. This should not be interpreted as a criticism of anyone but should be viewed in a constructive manner to obtain the benefit that this survey has made to the searcher. It is quite obvious that the petroleum industry is making use of the opportunity to tremendously minimize accidents of every description. But more effort must be made to reduce the staggering cost of material, equipment, lost time, and high insurance rates, as well as saving the lives and increasing the efficiency of the workers.

The author suggests that a report of every accident resulting in lost time, partial or total disability, and death as well as loss of plant, equipment, or production, and of greater importance the cause of accidents should be made to the Central Committee of API. Top management should make such reports compulsory.

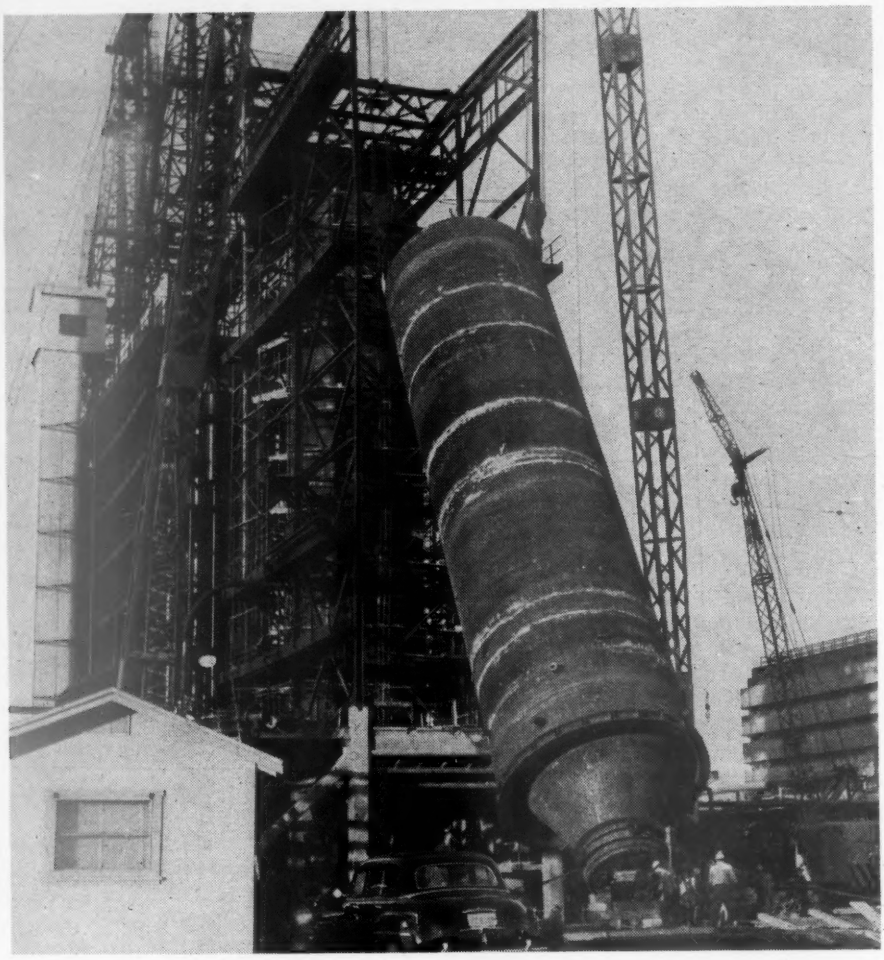
From a careful study of each accident the hazard involved can be analyzed and provision made to eliminate it if possible, or guard against future similar accidents.

The cumulative results of such a program of study will be most enlightening to all companies in the same field; and all companies should participate. Just as there would be a good inflow of data, there would also be a healthy outflow to the industry. In time it should expand to cooperate with colleges specializing in the training of safety engineers. Emphasis placed at the training level can result in a more dynamic program to eliminate potential hazards.

While the cost of such a program may be considered substantial, it nevertheless, would be nominal in comparison to the cost each year of the many accidents that can definitely be eliminated. Accident prevention should receive the same important consideration as a necessary function as the production of any large process plant that has been installed to make profits. Accidents can be capitalized and will save large sums of money provided they are properly studied and the results utilized. There is nothing insurmountable in the prevention of accidents; it is just a question of doing a real job as in any other undertaking. A concentrated cooperative effort of the majority is required, and it must start from the top and work down.

Accident tolls throughout the years in all industry have created a vacuum that will inevitably draw in union and governmental directives unless each industry immediately adopts measures to fill the void. The petroleum industry presently has the opportunity to set the pattern for all industry.

* * *



Giant cranes lift 120-ton steel drum for General Petroleum Corporation's coker.

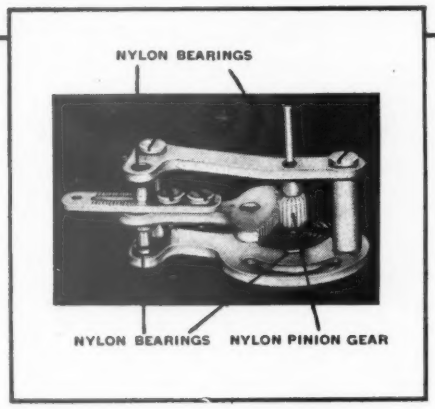
Coker Unit Added to Torrance Refinery

A newly-expanded refinery unit that will turn more surplus heavy fuel oil into other petroleum products in greater demand was put "on stream" for the first time January 22, at General Petroleum's Torrance refinery. The unit, known to refinery men as a "coker," has been added to at a cost of $2,250,000. The original unit was taken off stream for maintenance work and to be tied into the new addition to the plant.

Working together, the original unit of four coke drums each 80-ft high and 17-ft in diameter, and the two drums just added, will turn about 22,000 bbl (of 42 gallons) of heavy fuel oil each day into gasoline, gas oil, petroleum gases suitable for use as "bottled" gas, dry gas, and coke.

The coke—over 800 tons daily—is used in the aluminum reduction industry for electrodes. It is also useful as a fuel having, in fact, as much heat as the fuel oil from which it is made on a pound-for-pound basis. * * *

Every Engineer should read this!



THE TREND in gauge movement design over the years has been in the direction of increased bearing diameters and lengths, width of tooth engagement, hardness of wearing surfaces, and mass of parts in order to achieve *greater wear resistance.*

But in increasing the mass of parts, accuracy and sensitivity are invariably impaired and wear resistance is not necessarily improved. The high impact effect at bearing and other wearing points, which is related to the natural weight of the metal used, *creates wear!* The "products of wear" increase the rate of wear and when carbon particles are exposed, they rust.

The ideal conception of a gauge movement should, therefore, incorporate lightness in parts which move to enhance sensitivity and accuracy of indication and to lessen impact effects on severe service. The "products of wear" should not cause increased wear or be susceptible to atmospheric corrosion. The materials used at bearing and other wearing points should absorb or soften impact. Adequate strength and general corrosive resistance must be provided.

The Ashcroft Duragauge Nylon-Aluminum Movement* is a break with tradition, a completely new and revolutionary approach to movement design. It meets fully all these requirements!

The nylon parts provide impact absorption, retention of accurate form shape under sufficiently high temperature, no objectionable wear products (should any form), low friction and adequate corrosion resistance.

Aluminum contributes lightness in the mating parts which reduces potential impact to its lowest terms and increases sensitivity. The anodized surfaces enhance the low frictional properties of the aluminum. In contact, the aluminum tends to glaze the nylon which increases the wear resistance and lowers the coefficient of friction. The general corrosive resistance of aluminum is very good. And even in the case of such chemicals as methyl chloride and methyl bromide, which should not be used in direct contact with aluminum base alloys, the Nylon-Aluminum Movement in the Duragauge Vapor Proof case stood up well.

In laboratory and field tests on the worst pulsating services to be found, the Duragauge Nylon Movement outwore all other movements of whatever material or design.

In installations on "killing" services in refineries, chemical plants and power stations, the Nylon Movement showed its inherent superiorities.

We invite your inquiries concerning this new Ashcroft Duragauge movement.

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Conversion of Atmospheric Cooling Tower*

RAYMOND TODD†

Conversion of Atmospheric Cooling Tower

Faced with necessity for expanding the cooling capacity of an atmospheric cooling tower without changing the site of the tower, three solutions were possible:

1. **Installation of radiator type cooling at overall cost of $105,000.00.**
2. **Construction of a new induced-draft tower, at a cost of $96,000.00.**
3. **Conversion of the old tower to induced-draft, to cost $55,000.00, exclusive of certain equipment needed.**

The third alternative was chosen. The details of how it was accomplished and the efficiency attained, are given in this highly practical article.

DURING the past summer Pacific Lighting Corporation has completed the reconstruction of a 29 bay atmospheric type cooling tower so as to convert it to induced draft operation. This tower is part of the facilities installed at the Goleta Gas Storage field, situated approximately 8 miles north of Santa Barbara, California.

Several reasons prompted consideration of revisions in the atmospheric cooling facilities that existed at the Goleta plant.

First, the unsightly appearance of the existing tower detracted from the overall appearance of the plant facilities.

Second, the high cost of maintenance of the surrounding plant facilities due to the water spray from the cooling tower. The tower was situated on the windward side of the main compressor building, and, therefore, the trench piping and other equipment around the plant were continually exposed to the cooling tower spray.

Third, the large amount of water wasted from the atmospheric tower in the form of spray and wind loss. A check of plant operating data indicated that cooling tower spray and wind loss at times amounted to as much as 25 per cent of the total plant water consumption. Wind loss from the tower with only a moderate wind has amounted to as much as 30,000 gal of water per day. In view of the difficulty in developing water in this area, such a large loss of water was of major importance and, therefore, was one of the primary reasons that prompted consideration of the revision of the cooling facilities.

Fourth, the cooling capacity of the atmospheric tower was inadequate under centain atmospheric conditions.

Inasmuch as these cooling tower problems are common to the operation of most atmospheric towers, it was felt that a brief presentation of the changes that were made in the facilities to overcome these difficulties might be of benefit to others.

The cooling facilities at Goleta are a part of the compressor and dehydration plants that were installed in conjunction with the injection and withdrawal of natural gas in underground storage. The tower provides cooling for several different operations consisting of:

1. Cooling of gas that is withdrawn during the winter time.
2. Cooling of compressor engine jacket water while gas is being injected for storage during the summer.
3. Cooling of diethylene-glycol in conjunction with the dehydration of gas during periods of withdrawal.

The original cooling tower installed at Goleta was constructed in 1939 and consisted of 6 bays. As the Goleta storage project developed and facilities were extended, this original tower was extended until in 1948 it consisted of 29 bays, was 179 ft in length and 43 ft in height including the coil shed. The cooling tower itself was 12 ft in width and was installed over a coil shed that housed the cooling coils for the various services.

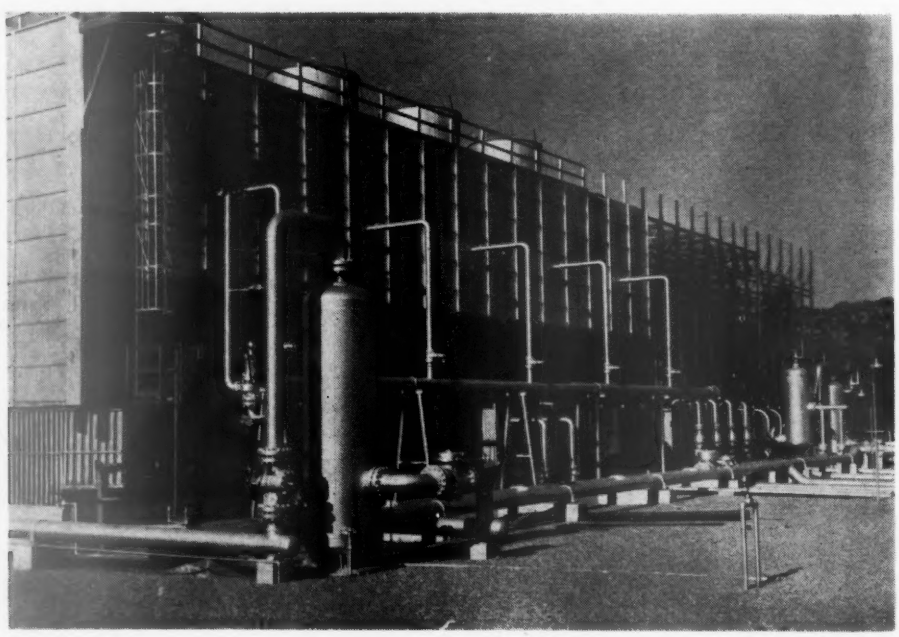
In endeavoring to arrive at the most economical means of solving the problems presented by the atmospheric cooling tower, consideration was given to the following types of installations:

One possible solution of the prob-

*Presented before California Natural Gasoline Association, November 3, 1949.

†Chief Engineer, Pacific Lighting Corporation.

Structural portion of second half of cooling tower to be worked upon.



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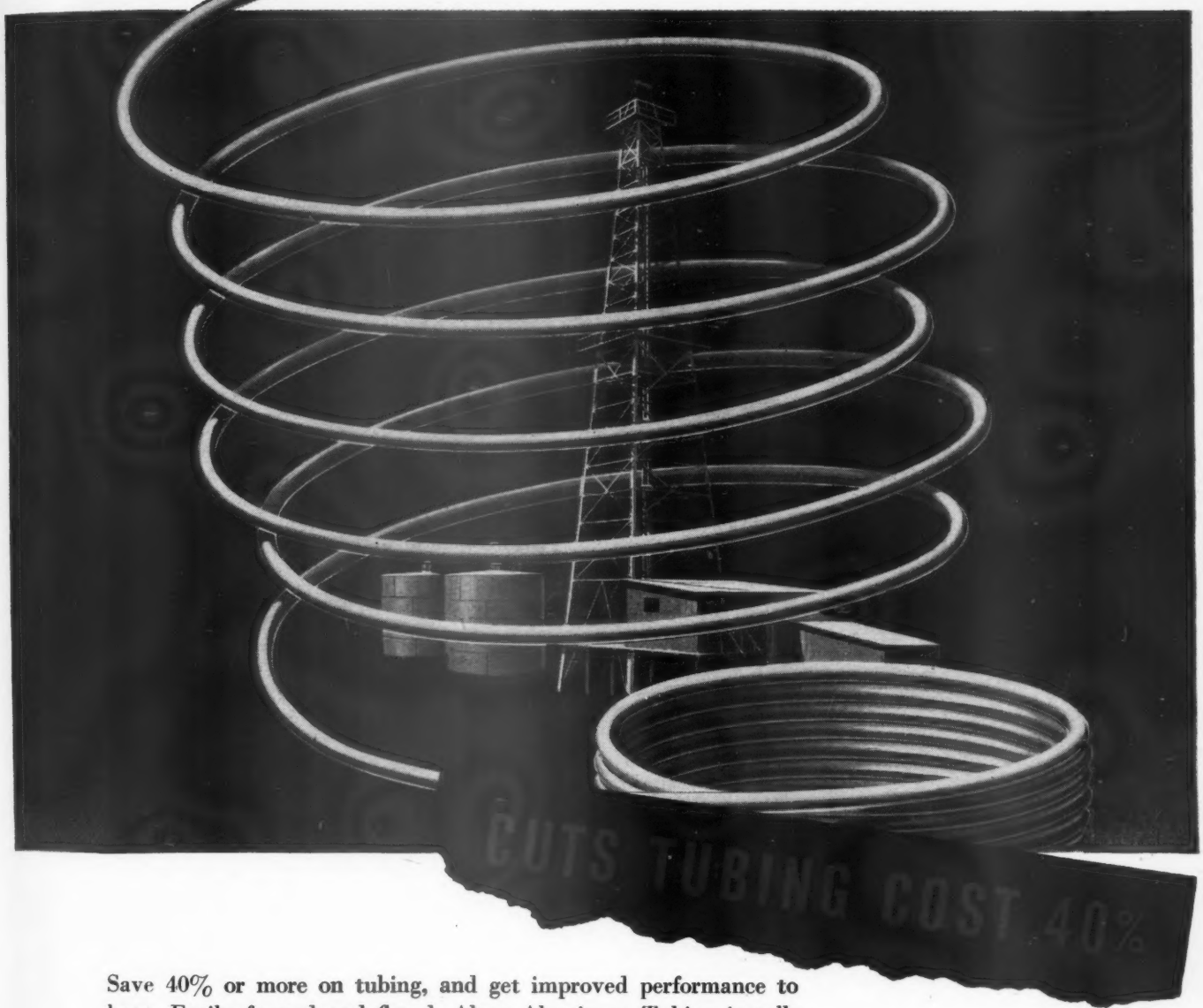

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lem was to install radiator type cooling. This type of cooling is very desirable inasmuch as it entirely eliminates the use of water as the facilities consist of fans blowing air across the extended fin coils. A disadvantage of this type of cooling is that it generally is not practical for cooling services where temperatures lower than 15 deg above the ambient air temperature are necessary. The jacket water cooling at Goleta met these requirements. Cooling of gas and glycol during withdrawal periods did not come within this temperature range, and, therefore, some other type of supplementary cooling would have to be provided. Inasmuch as the atmospheric tower was unsatisfactory, it did not seem advisable to maintain a portion of it for the lower cooling requirements. The only alternative would be to install an induced draft tower in the location of a portion of the present atmospheric tower and utilize a portion of the present cooling tower basin. This would eliminate the necessity of relocating and repiping the gas and glycol cooling coils. Such an installation, it was estimated, would cost $60,000.00. The radiator type cooling equipment for jacket water would cost, completely installed, along with necessary piping, $45,000.00, which would make a total cost of $105,000.00 for these cooling facilities.

A second possible solution would be to install a new induced draft cooling tower for all cooling requirements. Operating conditions at Goleta made it impossible to install a new induced draft tower in the location of the present atmospheric tower. An induced draft tower to handle all cooling requirements would consist of three (24 ft x 24 ft) cells and would cost, completely installed, with concrete basin, approximately $60,000.00. The installation of the jacket water and gas cooling coils in a new induced draft tower along with necessary piping would cost $36,000.00, or a total cost of approximately $96,000.00.

The third solution would be to alter the present cooling tower to convert it to induced draft operation. Inasmuch as the structural portion of the existing atmospheric tower and the concrete basin were in good condition, it was felt that consideration should be given to converting the present tower to induced draft operation. The above figures show that the installation and repiping of the cooling coils in the new induced draft tower amounted to over 1/3 the total cost, and, therefore, if this work could be eliminated, a major saving could be effected. In view of this apparent saving, preliminary estimates were made covering the costs of converting the atmospheric tower to induced draft operation. These estimates indicated that the tower could be reconstructed for approximately $55,000.00. In view of the large difference in cost between this method of solving the cooling problem and the other possible installations, it was decided to proceed with the detailed design of the reconstruction of the atmospheric tower.

In order to be assured that the conversion of the tower would solve the various problems with which we were confronted, the following requirements were set up.

1. The wall of the tower was to be of double construction with the inside surface of 1 in. T&G Redwood and the outside surface of 3/8-in. waterproof plywood. These two surfaces to be separated by air space 1 3/4 in. wide. The air space was to be continuous and open at both top and bottom so as to prevent any carryover of moisture from the inside wall to the outside wall. Recent experience in maintaining the exterior surface of induced draft cooling towers had shown that a plywood surface stood up better and presented a better appearance than a surface of 1 in. T&G redwood.

2. All joints on the wall panels for the cooling tower structure that extended to the outside were to be sealed by mastic in order to eliminate any possible leakage of water.

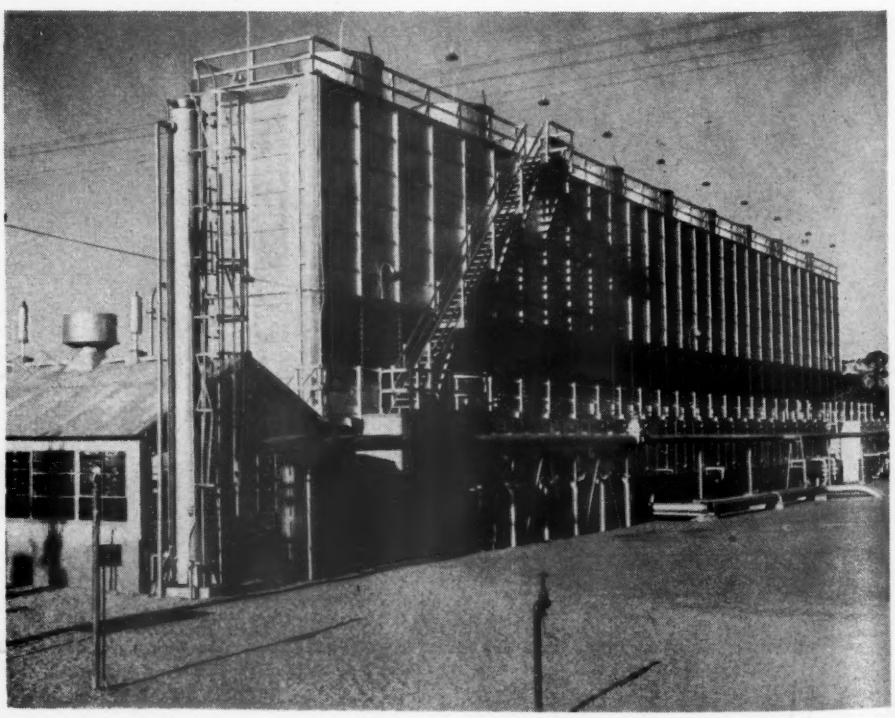
3. In order to make sure that the construction of the tower would be waterproof in all respects, we specified that the exterior of the tower should be free from any leakage for a period of one year and in the event leaks did occur, the contractor would make the necessary alterations to repair such leaks at his own expense.

4. The performance of the cooling tower was to be guaranteed to cool 3000 gal of water per minute from 88 F to 73 F with 66 F wet bulb temperature. These were the same cooling specifications for which the atmospheric tower was designed with the exception that they were based on a 3 mile-an-hour wind through the tower. There was to be incorporated in the guarantee a set of performance curves that would set forth the guaranteed performance for all wet bulb temperatures within a specified range.

In order that the tower structure might carry the added loads imposed on it by fans, their operating equipment, and the additional wind load resulting from the side of the tower being covered solid, it was necessary to reduce the overall height of the original tower by 8 ft and improve the joint efficiency in the diagonal bracing. This was accomplished by installing brass gusset plates between the diagonal bracing and the vertical members in the cooling tower.

In view of the 12 ft width of the original cooling tower, the maximum size fan which could be installed was 8 ft in diameter. In order to meet the cooling conditions, it was necessary to install nine fans on top of the tower, each one drawing air through a separate cell. The two end cells on the tower were 12 ft x 24 ft, while the

View of the tower following its conversion from atmospheric to induced draft operation



remaining seven cells were 12 ft x 18 ft. The end cells, being larger, required more air be drawn through them, and, therefore, the fans on these cells were driven by a 15 hp motor whereas the remaining seven fans were driven by 7½ hp motors.

The cooling tower fan motors were to be controlled from a central panel board placed in the auxiliary room adjoining the main compressor engine building. This panel board, in addition to starting and stopping switches for each individual motor, was to be equipped with lights that indicated which fans on the tower were in operation. It was also necessary to provide for disconnect switches at the individual motors to prevent their being started by the remote control switch during the time the fan mechanism was being worked on.

Inasmuch as the fill in the old atmospheric cooling tower was designed for a horizontal passage of air through the tower instead of the vertical movement of air which occurs in an induced draft tower, it was necessary to remove all of the fill from the tower and replace it with a new fill which was designed for induced draft operation. It is generally agreed that it would have been impossible to utilize the old fill material in converting the tower to induced draft operation.

Following the working out of the details in connection with converting the tower, the tower supplier furnished us with a proposal whereby they agreed to perform all work in connection with the conversion of the tower to induced draft operation for a fixed price with the exception of the cost of removing the old exterior surface of the original tower and the removal of the fill in the tower. This work was performed on a cost plus basis in view of the indefinite amount of work which would be involved in the removal of the exterior surface and the tower fill.

Inasmuch as the entire cooling tower could not be taken out of operation for a period long enough to perfrom the conversion work, it was specified that only one-half the tower could be converted at a time and the work on the first half of the tower would have to be completed before work could be started on the second half. The conversion work was started about the first of May and required a period of approximately two months. Following the completion of the conversion of the tower, performance tests were made on the tower to determine if it met the guaranteed conditions. These tests indicated that the cooling tower, when operating within the range of the performance curves, gave approximately ½ deg closer approach to the wet bulb than was required under the guarantee.

Final costs of all work performed in connection with the conversion of the tower to induced draft operation show that the complete job, including all electrical work and painting the completed tower, amounted to $62,-275.00.

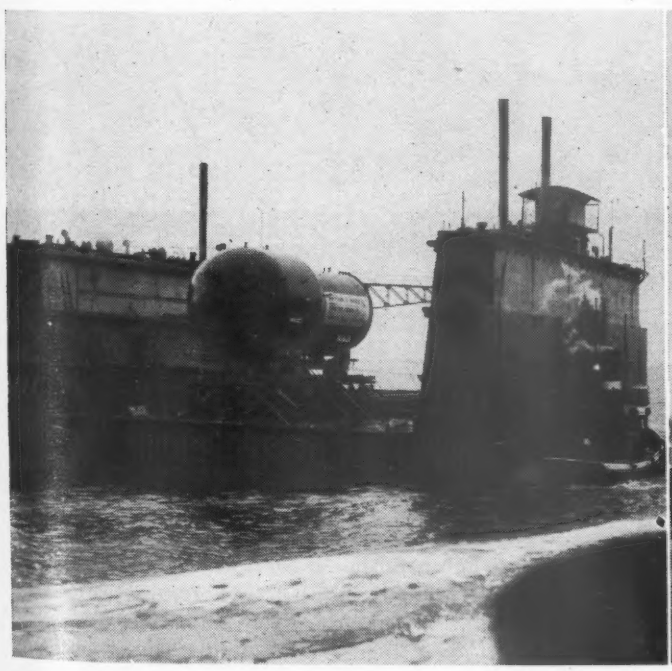
The cost of the electrical installation including motor controlling equipment, wiring, etc. was approximately $4000.00, which, if omitted from the above figure, would leave a net cost for the actual conversion of the tower of $58,275.00. * * *

Huge Catalyst Regenerator Floated and Hauled to Montreal

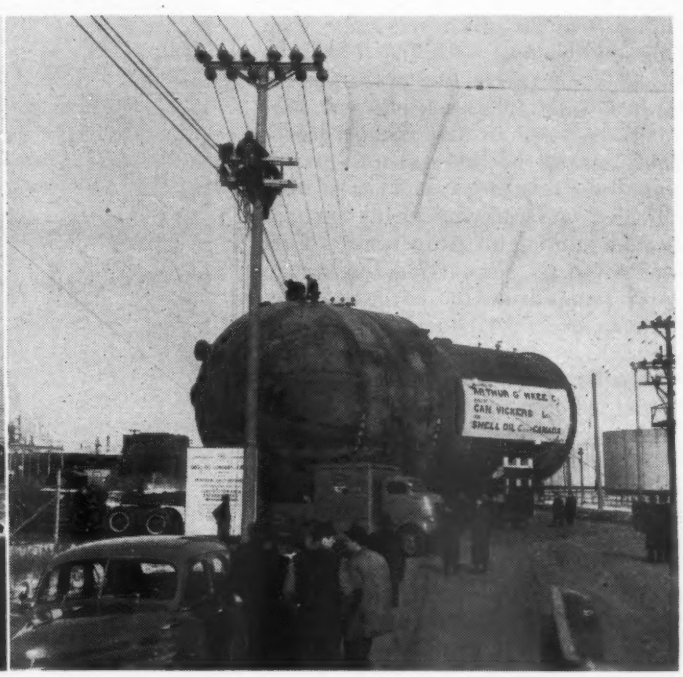
Manufactured within 2½ months of the date of the contract, a 105-ton catalyst regenerator vessel has been floated successfully a distance of more than five miles. A land haul of three miles from the fabricating site in the plant of Canadian Vickers in Montreal brought it to the Shell Oil Company's refinery at Montreal East, by the use of a floating dry dock, and specially built trailers. Designed by A. G. McKee Company of Cleveland, Ohio and built by Vickers, the vessel was sent down the ways and maneuvered into the jaws of a submerged floating dock; on the dock's floor and below the level of the water were the two trailers built for the job. As the dock rose the vessel was settled onto the trailers for the long trip.

The 3-mile land journey took less than two days. The entourage required a clearance of 32 ft height and 29 ft width; hydro and phone wires and other obstructions were removed entirely to make the trip possible. Bulldozers attended the carrier and swung around sharp turns with lines fast to the vessel to prevent overturn.

This is the first time a vessel of this size has been fabricated entirely in the factory and transported whole to erection site, say Canadian Vickers.



Catalyst regenerator of 105 tons in floating dry dock.



Vessel enters Shell's Montreal refinery on two trailers.

Test Engines Give 150 Miles per Gallon

ARCH L. FOSTER*

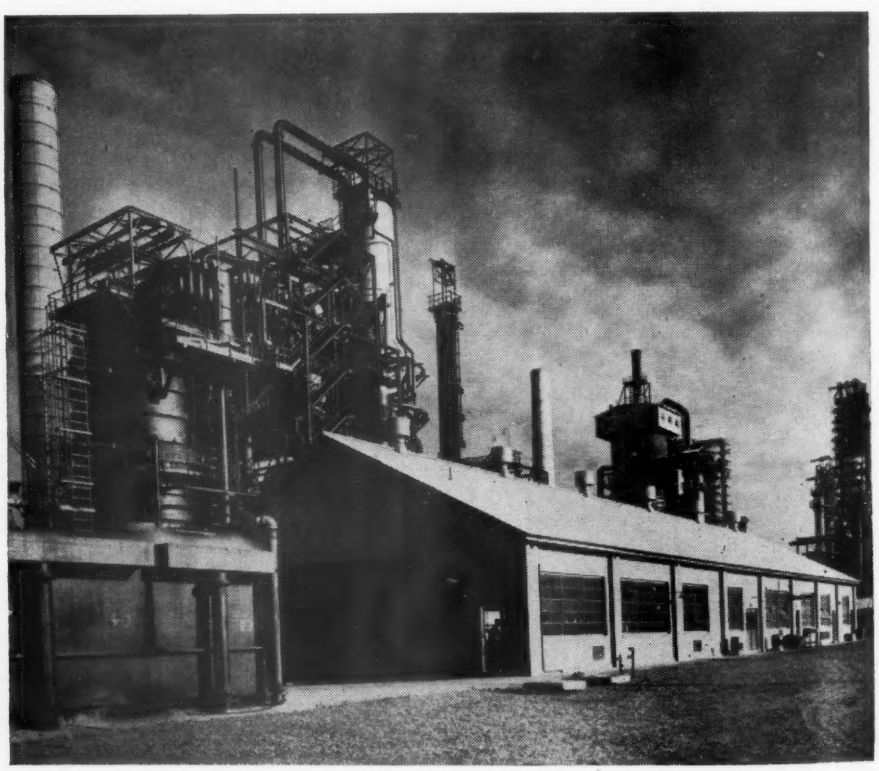
Commercial cars with engines specially fitted and "tuned up" have been operated on a standard commercial premium motor fuel to obtain more than 150 road miles per gallon of fuel in the 1949 Mileage Marathon, held by Shell Oil Company engineers annually since 1939, except for the war years. These contests, begun because of arguments between engineers as to whose car gave the best mileage, are showing a large number of points that can be improved to increase the economy of the typical gasoline engine, R. J. Greenshields director of Shell Company's Wood River Research Laboratory indicated before the January, 1950 annual meeting of the Society of Automotive Engineers in Detroit.

In the Class A entries in the 1949 contest, in which practically any changes could be and were made in the engine system, the three top mileages per gallon of fuel were 158.36, 149.95, and 121.84. To achieve these results the operators of the cars made a multitude of changes; to eliminate lost power, fan belts were removed to avoid using engine power to run accessories, generator, fan, etc. An accelerate-coast routine of operations was adopted, in which the car was accelerated at full throttle in top gear from about 5 to 20 miles per hour, then allowed to coast with free clutch to about 5 mph when the cycle was repeated. Inlet fuel manifold was normally enclosed by the exhaust manifold, to raise fuel-air mixture to optimum temperature; crankcases were shielded and radiator fronts covered to maintain engine temperatures. Fuel was saved by eliminating the accelerator pump from the carburetor, by running at 15:1 air-fuel mixture ratio or higher, just below the lean point where the engine begins to misfire. Compression ratios of 10:1 were used, and combustion chamber deposits were cleaned out frequently to avoid knock. Spark settings for minimum specific fuel consumption were set by road test; spark gaps wider than normal, up to 0.035-in. were employed to improve consumption on the very lean mixtures. Innumerable other advantages were taken of conditions to obtain the utmost mileage possible.

Among other things found was that specific fuel consumption is increased greatly at light loads; fuel consumption in one car reached a maximum of about 1.5 lb/hp/hr at very light loads, and is reduced to as low as 0.5 lb/hp/hr at full throttle. Although the operating conditions for these contests cannot be duplicated by the average motorist, the findings from these operations are showing the way to the reduction of many different variables that reduce strongly the efficiency of the modern automotive engine, Greenshields pointed out.

The direct results of the first research on knock in fuels in 1916-18 aided aviation operations in World War I, and improved fuels used in a Liberty engine enabled a flying major to attain an altitude of 36,000 ft just after that war, T. A. Boyd, General Motors consulting engineer, stated. The improvement in fuels resulting from research since 1930 has increased engine-fuel efficiency about 30 per cent, Boyd said, equal to $2 billion savings annually to America. Doubtless the greatest effect of the finding of tetraethyl lead is the spur to intensive research and improvement that resulted.

The serious mixture distribution problem is still very much alive, say R. W. Donahue and R. H. Kent, Jr. of Sun Oil Company, reporting on the results of their studies of this field. Maldistribution in many engines is comparable to that reported 10-15 years ago and it has been shown that the position and design of many parts of the induction system, such as the choke valve, may alter the pattern of fuel distribution more than large.



This new atmospheric and vacuum pipe still is designed to process 40,000 bbl of crude oil per day in The Texas Company's new refinery at Eagle Point, New Jersey. Products obtained are gas, light and heavy straight run naphthas, gas oil, and various residual products—all going to other units for further processing. This unit was designed to process high sulfur crudes now coming to refineries in increasing quantities. The East Coast Area from Jersey City to Wilmington, Delaware, is becoming the No. 2 American refining center, where $300,000,000 is being spent currently on new capacity. Main center is the Gulf Coast Area.

*Refining Editor.

changes in engine speed and other seemingly more important factors. These researchers found that the lighter fuel components are unevenly distributed as well as the heavier components, although earlier it was thought that only the heavier fractions suffered this maldistribution. Probably the most important discovery of all from the refiner's viewpoint is the finding that the octane number of the fuel reaching the cylinders is a function of the variation of octane quality with boiling range of the original fuel; thus the "working octane number" in the cylinders may be controlled in great measure by maintaining an even anti-knock quality between the light and the heavy fractions of fuels, these authors stated. Obviously this situation will be aided by the use of catalytic cracking, as the octane rating of heavy ends of catalytically cracked fuels is maintained more nearly equal to that of the light ends than is the case with either straightrun or thermally cracked components.

A compromise condition exists in the use of lubricating oils for automotive engines between the requirements for easy cold starting and for low oil consumption, C. L. Fleming, Jr., B. W. Geddes, N. V. Hakala, and C. A. Weisel of Standard Oil Development Company report. Easy cold starting needs low viscosities at low temperatures; low consumption calls for high viscosities at high temperatures. These opposing requirements are met best by oils of high viscosity index (that is, VI).

The authors showed how conditions are met by giving the viscosities of a high and a low VI oil; a 40 VI oil and a 155 VI oil having the same viscosity at 210 F, (52 SUV), show a viscosity, extrapolated, of 300,000 SUV at minus 10 F for the 40 VI oil, and only 4900 SUV at minus 10 F for the high VI oil. As to ease of starting at low temperatures the extrapolated viscosities of oils containing with or without creditable VI improvers is a reasonably reliable index of their relative performance in starting. Two oils of the same viscosity at minus 10 F, one containing a VI improver, the other without it, showed the same cranking speeds; two others of lower viscosities showed similar and higher cranking speeds. Analogously, it was found that when comparing the viscosities of oils at 300 F, their consumptions in service correlate reasonably well with their viscosities, whether or not VI improvers are employed. Three ranges of viscosity oils of 35.7, 42 and 38 SUV seconds respectively, some with improvers, some with bright stock and some without either, showed consumption percentages of 100, 50, and 70-80 respectively, the bright stock-containing oils showing a tendency toward the higher consumptions in these data.

No clear-cut and final answer can be given to the question "Does tetraethyl lead suppress knock by controlling prereactions?," E. R. Retaillaiu, H. A. Ricards, Jr., and M. C. K. Jones of Esso Laboratories, SOD stated. They found, however, that in fuels leaded to 3 ml TEL per gal addition of lead decreased the extent of prereactions occurring in paraffinic fuels, has little influence on benzene that agrees with experience on the poor lead susceptibility of benzene. Benzene shows little if any prereactions; therefore it may be supposed that TEL will show little effect when no prereactions are present in its (TEL's) absence.

Treating West Texas gasolines with TEL showed a reduction in prereactions, indicating the possibility lead may react with some of the "active centers of oxidation chain propagators"; tests with 75 per cent isooctane and 25 per cent of n-heptane with 4.6 ml TEL per gallon shows that, though lead may react with some of the "active dation of the fuel, it probably destroys a large proportion of the centers of the oxidation propagation chain and decreases the development of prereactions, permitting an increase in engine operating severity before the initiation of preignition. Very important reactions may occur during the compression stroke altering the fuel composition and making it decidedly different at the time of ignition from the original fuel inducted into the cylinder.

* * *

New Principles in Heat Exchangers

No little degree of interest is evidenced among chemical engineers in the petroleum and chemical industries in the new heat exchanger announced recently by Arthur D. Little, Inc. The principle of the new exchanger appears to be that of a series of perforated metal plates, separated by gaskets into alternating "hot" and "cold" passageways. Intercommunication between the passages is prevented by the regular recurrence of the gasket units, which are a series of strips at regular intervals that divide the exchanger interior space into paths. The units so far are built for gas-to-gas exchange only.

In one unit constructed so far an aluminum header guides the two gases —nitrogen and air—to their respective channels. Above this header are piled alternately thin punched aluminum plates and neoprene gaskets until 700 plates are incorporated in this part of the unit. For the upper or "cold" exchanger section the same arrangement exists, a header distributing the two gases through a set of 380 plates and gaskets. The gaskets are varied as to their location, shunting the streams of gas back and forth to improve the rate of heat transfer.

New wrinkles are being developed to simplify construction and assembly and to cut costs. One of the major "tricks" envisioned and being tried is that of "bumps" or "dimples" pressed into the metal sheets, which contact each other and make a complete gas seal, eliminating the gaskets entirely. One major advantage of this system is that if additional capacity is needed it can be attained by adding more plates above or below those in use, without disturbing the setting of the old installation. The plates may be spring-loaded to insure tightness of joints; the assemblies of plates and gaskets are held together by rods running from top to bottom. The plates are held in line during assembly by removable I-beams.

New Uses of Ceramics

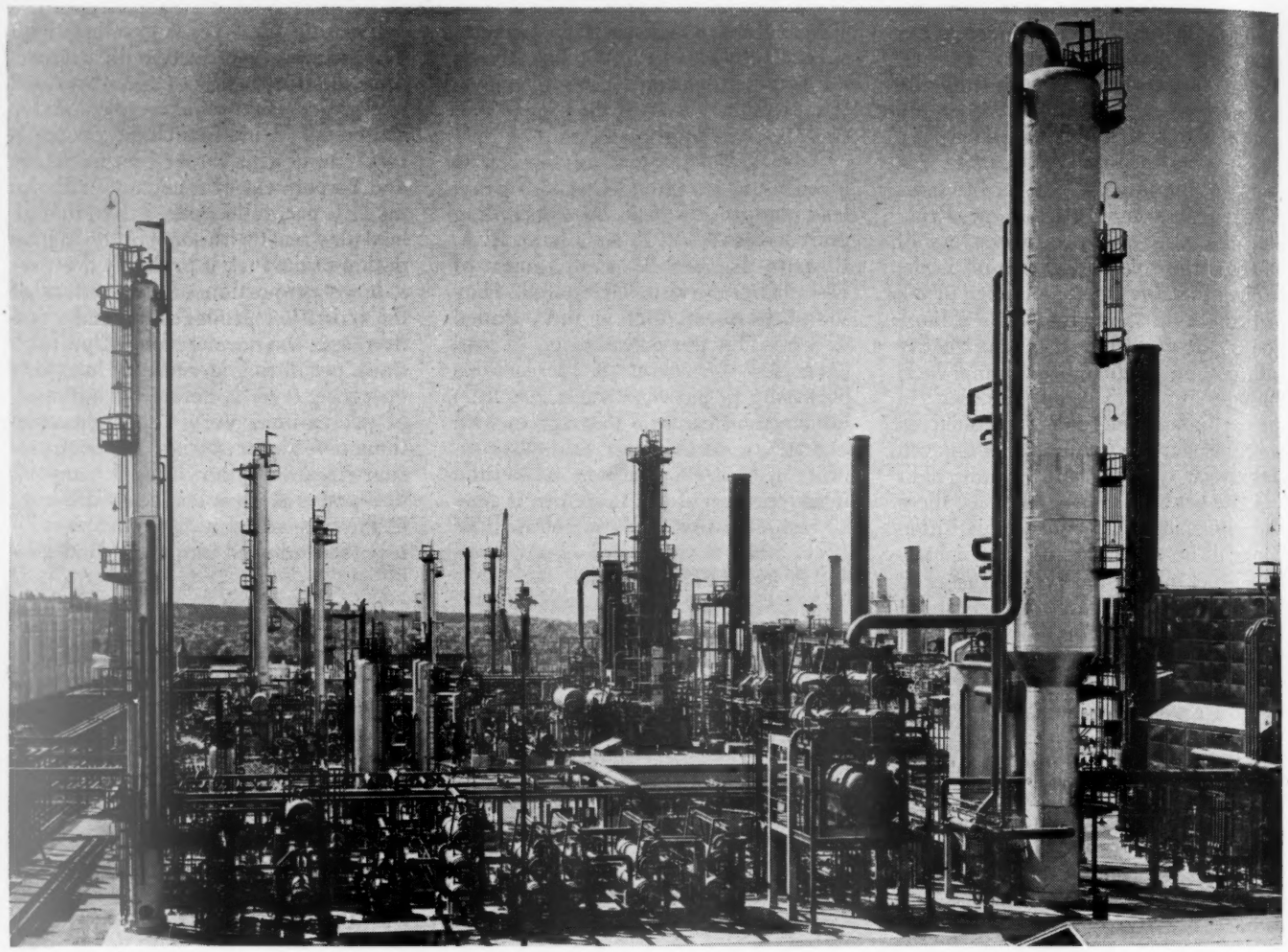
Due to shortage of quartz crystals and especially of larger sizes of crystals, the use of various shapes of ceramics material as generators of ultrasonic energy is being developed by Brush Development Company, for use in many industrial production and research operations. Discovery of the piezoelectric properties of these ceramics materials containing titanium was made first during World War II by Titanium Alloy Manufacturing Company, division of National Lead. These products are being made now in a wide range of sizes, according to A. L. Williams, president of Brush.

B-A to Open New Unit

Scheduled for opening in May, 1950, a new propane deasphalting unit is being erected at the Clarkson, Ontario, refinery of The British American Oil Company.

The $400,000 unit, when completed, will be used for the production of high quality lubricating oils in the "bright stock" classification.

Construction comprises a unit consisting of several pressure vessels, exchangers, condensers and coolers; furnace, pumping, compressing and control equipment, plus the necessary piping. Operation of the new unit will be absorbed into overall operations.



View of Standard of California's Bakersfield refinery, now being enlarged and modernized.

Cities Service Gets New Natural Gasoline Plant

Cities Service Oil Company's Chico natural gasoline plant in Wise County, Texas, 45 miles northwest of Fort Worth, was placed on stream and processes 12,000,000 cu ft of gas daily.

Wise County's only natural gasoline plant was built in six months and includes both high and low pressure gathering facilities. Liquefied petroleum products and residue gas are going to local markets. The plant has been so designed that the capacity can be expanded to 22,500,000 cu ft.

Bakersfield Refinery Undergoes Modernization

For the past 17 months the Bakersfield refinery of Standard Oil Company of California, has been the subject of a modernization program designed to improve product quality, and to increase by 50 per cent the amount of crude oil which can be processed daily. On completion, the refinery will provide a more direct source of gasoline and other oil products for the San Joaquin Valley areas now served by Standard refineries on the Pacific Coast.

Principal new facilities include a crude unit, recently placed in operation, a cracking unit, and a gasoline finishing plant, which will raise crude oil processing capacity to 20,000 bbl daily. Other major installations are a steam plant, cooling tower, and additional tankage. These new facilities are designed to produce a daily average of 8000 bbl of gasoline, 2200 bbl of stove oil, 1900 bbl of diesel fuel, and 6000 bbl of fuel oil.

To Open Dunkirk Refinery

Societe Generale des Huiles de Petrol, affiliate of Anglo-Iranian Oil Company, Ltd., will open its new Dunkirk refinery in France within a short time, Anglo-Iranian has stated. Production set for the new plant is about 6000 bbl a day, but by fall of 1951 it is planned to raise production to 29,000 bbl daily. The refinery is situated on the site of the pre-war refinery of Raffinerie de Petrole de Nord, which had a capacity of about 10,000 bbl a day. Societe Generale will use crude oil shipped from the Persian Gulf.

Delayed Coking Solves Heavy Fuel Problem

The rapidly weakening demand for heavy, residual fuel oil has added another serious problem to the list of quandaries faced by the refiner. One important solution of this dilemma is the use of delayed coking type of cracking operation, by which the residuals are reduced to solid coke and to liquid fractions useful for a variety of purposes. Recent advances in the design of furnaces have extended greatly the length of on-stream periods possible. The delayed coking unit can be used for visbreaking.

Coking operations increase the total amount of clean liquid charge for catalytic or thermal cracking or for other purposes, and to boost cracking unit charge is often the most important consideration of the refiner, after that of ridding his tanks of unsalable heavy fuels. Kellogg-type delayed coking units have been in operation without shutdown for periods as long as six to eight months, and furnace tube inspections indicate that even longer periods are practicable.

Independent Refiners Meet

The Independent Refiners Association of America recently completed its permanent organization, elected officers and directors and appointed committees to study proposals for proration of wet gas used by recycling plants and the question of imposing tariffs on imported petroleum products at a two-day meeting of the executive committee and directors in Tulsa, Oklahoma.

Harry Leyendecker of Houston, Texas, vice president of Eastern States Petroleum Company, chairman of the executive committee, was elected its first president. He will serve a one-year term.

Other officers elected were: James P. Dunnigan, president of Producers Refining, West Branch, Michigan; M. Lloyd Freese, vice president, Bell Oil and Gas Inc., Tulsa; and M. H. Robineau, president, Frontier Refining Company, Denver, Colorado, all vice presidents. D. W. Hovey, president, Danaho Refining, Houston, was elected secretary-treasurer.

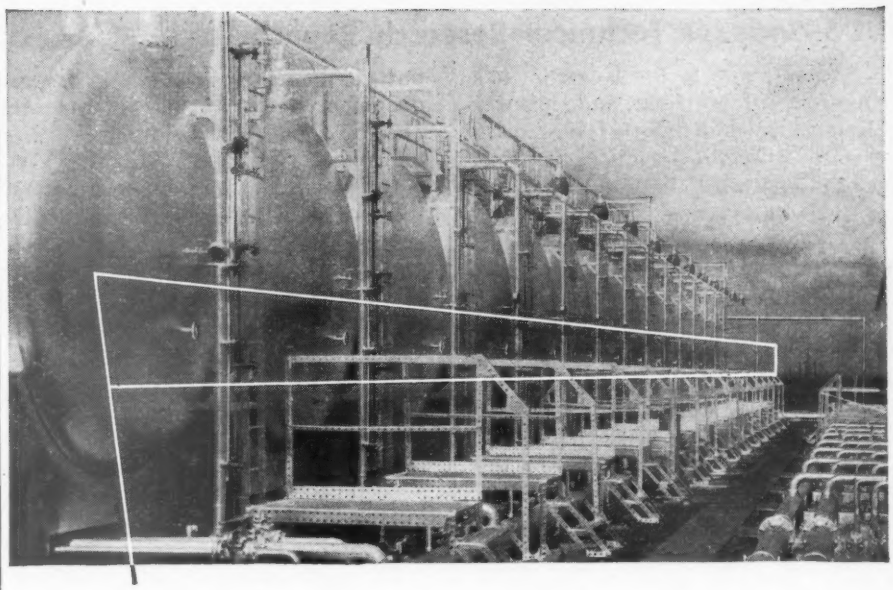
In addition to the officers, all of whom were elected to the board of directors, three additional directors were named—Fred C. Koch, president of Wood River Oil and Refining, Inc., Wichita, Kansas, D. E. Foster, president, Wisconsin Oil Refining, Sheyboygan, and Robert O. Anderson, president, Malco Refineries, Inc., Roswell, New Mexico. The directors announced they are preparing a statement of policy to be issued in the near future.

Headquarters of the association are in Houston.

Socony to Build Three Cracking Units

Plans for three more Thermofor catalytic cracking units to be constructed at refineries in Buffalo, New York; Beaumont, Texas, and Brooklyn, New York, were announced by the Socony-Vacuum Oil Company, Inc. These three are in addition to the four other units announced several months ago for Socony-Vacuum refineries at Trenton, Michigan; Augusta, Kansas, and at Beaumont. Contractors have started work on several. Completion of all is scheduled during 1950. The Beaumont refinery is operated by Magnolia Petroleum Company, a Socony-Vacuum affiliate.

In every case, the new TCC units with moving-bed catalysts will replace existing Houdry fixed-bed units. They will provide an increase of 50 per cent over the present 10,000-bbl per day capacity of each Houdry unit for a total throughput of 105,000 bbl daily. Each barrel has a capacity of 42 gal.



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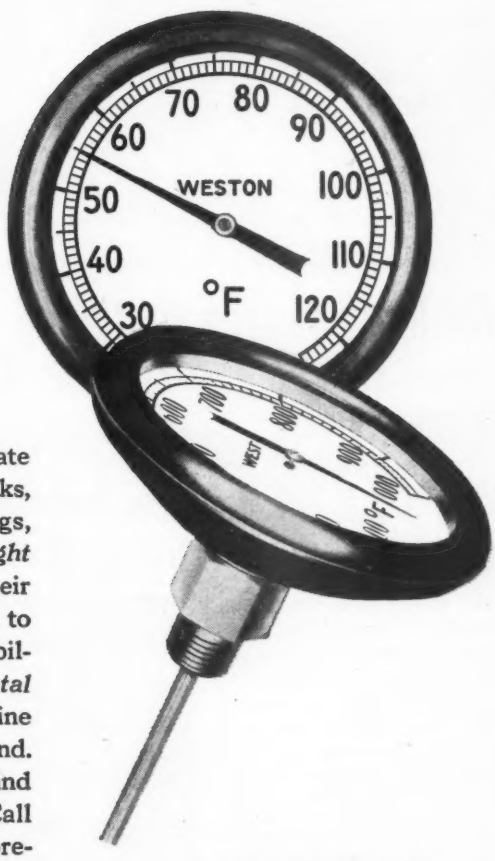

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WESTON *Instruments*

U. S. Indexes Technical Research Reports

A new guide to the Government's collection of wartime and postwar technical research reports is now available, the Office of Technical Services, U. S. Department of Commerce, announced today.

"The Numerical Index to the Bibliography of Scientific and Industrial Reports" (Volumes 1-10, 1946-1948) is a joint production of the Science-Technology Group of the Special Libraries Association, the Socony-Vacuum Laboratories of Paulsboro, New Jersey and the Office of Technical Services. It is being published by the Special Libraries Association.

In the "Numerical Index" "PB" reports of the Office of Technical Services are listed by number. The "PB" reports listed are those which have appeared in the first ten volumes of the *Bibliography*, published since 1946 by the OTS. Alongside each PB number is provided the volume and page of the *Bibliography*, so that additional details, including the abstract can be obtained by researchers using the index. Formerly this information could be secured only from the OTS catalog in Washington.

The "Numerical Index" also lists the PB number corresponding to reports in the following U. S. and British document series: British Intelligence (BIOS) Final Reports; Combined Intelligence (CIOS) Evaluation Reports; CIOS Roman Numeral Series; the British FD Series; Field Intelligence (FIAT) Final Reports; MDDC and AECD (Atomic Energy) Reports; and the Office of Scientific Research and Development (OSRD) Reports.

The Numerical Index to the Bibliography of Scientific and Industrial Reports, Volumes 1-10, 1946-1948, planographed, 530 pages, can be obtained from the Special Libraries Association, 31 East 10th St., New York 3, for $10. Orders should *not* be addressed to OTS.

Foreign orders can be placed through the American Booksellers Association, 31 Madison Ave., New York, which will accept UNESCO book coupons; or, if orders are sent directly to the Special Libraries Association, payment may be made to Stechert-Hafner, Inc., 16 Rue de Conde, Paris 9.

Beginning with Volume 11, July, 1949, the name of the *Bibliography of Scientific and Industrial Reports* was changed to the *Bibliography of Technical Reports.*

Record Oxygen Content

The extraordinary property of oxygen, possessed by only two or three other gases, that of being attracted by and into a magnetic field, has been employed recently as the primary principle actuating recording equipment to indicate and record the oxygen content of industrial gases. The number of applications of such equipment is legion, and the system is in wide use.

In practice, an electrically heated wire is suspended within a magnetic field. Gases containing oxygen are led through this field. As its temperature rises the oxygen loses its magnetic—paramagnetic—property and is thus pushed out of the field by the unheated oxygen-containing gas, which creates a gas current. This current cools the wire and changes its electrical resistance. As the wire is a part of a Wheatstone bridge, this creates an unbalance that is balanced again by operation of a balancing slide wire, which again balances the bridge and indicates or records the oxygen content. The differential shown is that brought about by the magnetic sensitivity of the oxygen at the temperatures employed, varied by the cooling effect on the hot wire in the field. One such instrument is made by the Hays Corporation, Michigan City, Indiana.

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PERSONALS

Warren L. McCabe, vice president and director of research of The Flintkote Company, was elected president of the American Institute of Chemical Engineers for 1950. **T. H. Chilton,** technical director of the development engineering division, E. I. duPont deNemours and Company, was elected vice president. The present incumbents, **S. L. Tyler** of New York City, secretary, and **C. R. DeLong** of New York City, treasurer, were re-elected to these offices.

Four new directors of the engineering organization were chosen. They were **C. G. Kirkbride,** vice president in charge of research and development, Houdry Process Corporation, Marcus Hook; **W. G. Whitman,** head of department of chemical engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts; **G. E. Holbrook,** assistant director of the technical division, organic chemicals department, E. I. duPont de Nemours, and **R. L. Murray,** executive vice president, Hooker Electrochemical Company, Niagara Falls.

George B. Hamilton, formerly a member of the technical and research division, The Texas Company, was recently appointed chief chemist at the Puerto La Cruz refinery of Venezuela Gulf Refining Company. Venezuela Gulf is jointly owned by Gulf and Texas.

James B. Irwin, Jr., has recently become a member of the petroleum chemical sales department of Monsanto Chemical Company. Irwin, assistant to the president since September, 1948, has been with the company since 1940. A native of Elizabeth, New Jersey, he received a BS degree from Princeton, and a MS from Washington University in chemical engineering.

Irwin was transferred from the Monsanto, Illinois, plant to the Longhorn ordnance works operated by Monsanto for the government at Marshall, Texas, where he served as an assistant area supervisor. He became an area supervisor in June, 1945 and returned to the Monsanto, Illinois, plant in October of that year as a member of the plant's development department. He is a member of the American Chemical Society and the American Institute of Chemical Engineers.

James W. Vaiden has been vice president of Skelly Oil Company in charge of manufacturing since 1941, and a director since 1942, but like most leaders in the oil industry the trail to that level led through plenty of work-infested 'jungles' of Oklahoma, Alabama, Texas, and Kentucky; the rattle and roar of World War I field artillery, and the problems and uncertainties of football and baseball coaching. Born in Alabama back in "the Gay Nineties" he got his military training early at Marion Military Institute, graduated to Officers Training School and commissioned at 21 as a field artillery lieutenant. In those days rookies started out as *privates* and *climbed* upward.

At war's end he took off for Alabama Polytechnic Institute, received a degree in chemical engineering in due time, joined Skelly in 1924 as a laborer; started again as a private. Thence he moved to linewalker, stillman, plant chemist, where he learned about refining and natural gasoline at first-hand. Superintendent then at Skelly's Stroud, Oklahoma plant, he in turn went in the same capacity to Coleman (Texas), Wynona and Seminole (Oklahoma). In spite of a strong taste for golf, and the pursuit of wild game ranging from quail to elk, he managed to concentrate so well that the assistant superintendency of the natural gasoline department signalled him to Tulsa in 1930; Jimmie Vaiden was 'on his way.'

Then, during the toughest decade the oil and gas industries have ever seen, he was advanced to superintendent (1934), and faced the period of increasing production, falling prices; was one of the wheelhorses in the all-out effort to enlighten the refiner to the advantages of volatility in motor fuels as one means of producing better gasoline. In 1941, just as we faced World War II Bill Skelly waved him up to the vice president's conning tower; the director's baton arrived the following year.

During the next eight years he was a member of the Petroleum Industry War Council, on its Natural Gas and Gasoline Committee; NGAA called him as president, 1943-45, most nerve-racking of the war years. Currently he is a director of the Natural Gasoline Association of America, Western Petroleum Refiner's Association. Not content with triple duties alone, he is also on the API general refining committee, and the very important committe on liquefied petroleum gas.

James W. Vaiden

At home in Tulsa, he lives with Mrs. May E. McDonald Vaiden, his wife; maintains memberships in the Tulsa and the Southern Hills Country Clubs; plays golf for the everlasting fun of it, goes hunting whenever he can break away from the multitudinous duties that grow heavier with the years.

J. R. Cox, formerly of Shreveport, Louisiana is now with Southland Oils, Inc., Sandersville, Mississippi. He will be superintendent of their Laurel refinery.

Robert L. Grun has been appointed chief fuels and lubricants engineer, process oil section, industrial producucts engineering, Gulf Oil Corporation, Pittsburgh, Pennsylvania. Grun, a chemical engineering graduate of the Pennsylvania State College, has been associated with Gulf since 1936 when he joined the refinery technology division at Philadelphia as an assistant chemical engineer. During World War II he served as a petroleum specialist with the U. S. Navy at various refineries on the East and Gulf Coasts, and was subsequently released to inactive duty with the rank of lieutenant commander.

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▸ **John F. Lynch,** president of the La Gloria Corporation, Corpus Christi, Texas, is to head the program committee for the 29th annual convention of the Natural Gasoline Association of America according to a recent announcement of NGAA President James E. Pew, Sun Oil Company, Philadelphia, Pennsylvania. The convention is scheduled for April 24-26 at the Texas Hotel, Fort Worth.

Other members of the committee include: **Z. C. Ambrose,** Southwest Gas Producing Company, Monroe; **W. L. Bowser,** Atlantic Refining Company, Dallas; **Otha H. Grimes,** Grimes Gasoline Company, Tulsa; **F. M. Matheny,** Sid Richardson Gasoline, Fort Worth; **Ralph Worley,** Parade Company, Shreveport, Louisiana; and **W. H. Vaughan,** Tide Water Associated Oil, Houston.

In commenting on plans for the three-day meeting, Pew stated the program would feature authoritative discussions of markets and promotion for liquefied petroleum gases. The Natural Gasoline Supply Men's Association will again be in charge of the entertainment at the NGAA convention. **J. N. McClure,** Elliott Company, Tulsa, has announced the "Chuck Wagon" committee, of which **L. L. Dresser,** Dresser Engineering, and **Malcolm Duncan,** Johns-Manville Sales Corp., Tulsa, are co-chairmen. Chairmen of other committees working with them are **Roy Blackbird,** Crane Packing, Houston; **R. P. Walker,** Brown Instrument, Tulsa; **J. A. Davis,** Continental Supply, Dallas; **J. B. Okeson,** The Refinery Supply, Tulsa; **W. H. Edwards,** Superior Mfg., Amarillo; and **M. A. Ellsworth,** Fluor Corporation, Tulsa.

▸ Sinclair Refining Company has announced the appointment of **Thomas B. Kimball** as assistant manager of refineries.

Kimball, who has been associated with the petroleum industry for nearly 27 years, was graduated from the University of California with a BS in chemical engineering. Upon graduation he was employed by the Shell Oil Company and after varied experiences in plant training and practices, he joined the Sinclair organization in the research and development department at East Chicago, Indiana. At East Chicago he was in charge of the cracking division and of the process engineering and development of light-oil processes. Later he transferred to the New York office as technical assistant to the vice president of manufacturing—a position he held to date. During the past several years he has developed numerous patents on light oil treating and on thermal and catalytic cracking.

Thomas B. Kimball

New NBS Standard Hydrocarbon Samples

The most recent additions of pure hydrocarbon samples to be added to the list available from the National Bureau of Standards, with their purities and price per unit are listed below:

NBS sample number[a]	Compound formula	Compound name	Amount of impurity[b] mole per cent	Volume per unit[c] ml (liquid)	Price per unit
580-5S	$C_{14}H_{30}$	n-Tetradecane	0.07±0.06	5	$35.00
581-5S	$C_{15}H_{32}$	n-Pentadecane	0.07±0.05	5	35.00
582-5S	C_7H_{14}	4,4-Dimethyl-cis-2-pentene	0.21±0.11	5	35.00
583-5S	$C_{10}H_{18}$	Cyclopentylcyclopentane	0.05±0.03	5	35.00
578-5S	$C_{11}H_{10}$	1-Methylnaphthalene	0.08±0.03	5	35.00
584-5S	$C_{12}H_{24}$	1-Dodecene	0.13±0.07	5	35.00
585-5S	$C_{10}H_{14}$	1,2,4,5-Tetramethylbenzene	0.14±0.04	5	35.00
586-5S	$C_{16}H_{26}$	n-Decylbenzene	0.20±0.16	5	35.00
587-5S	$C_{10}H_{12}$	1,2,3,4-Tetrahydronaphthalene	0.14±0.06	5	35.00

[a]The designation "-5S" following the sample number indicates a sample of 5 ml sealed "in vacuum" in a special Pyrex glass ampoule with internal "break-off" tip.
[b]The purity has been evaluated from measurements of freezing points, as described in J. Research NBS *35*, 355 (1945) RP1676 unless otherwise indicated.
[c]Tolerance approximately ± 10 per cent.

A complete list of all hydrocarbons available may be obtained by writing the U. S. Bureau of Standards, Washington 25, D. C.

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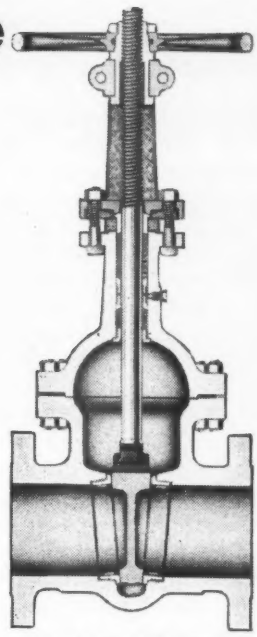

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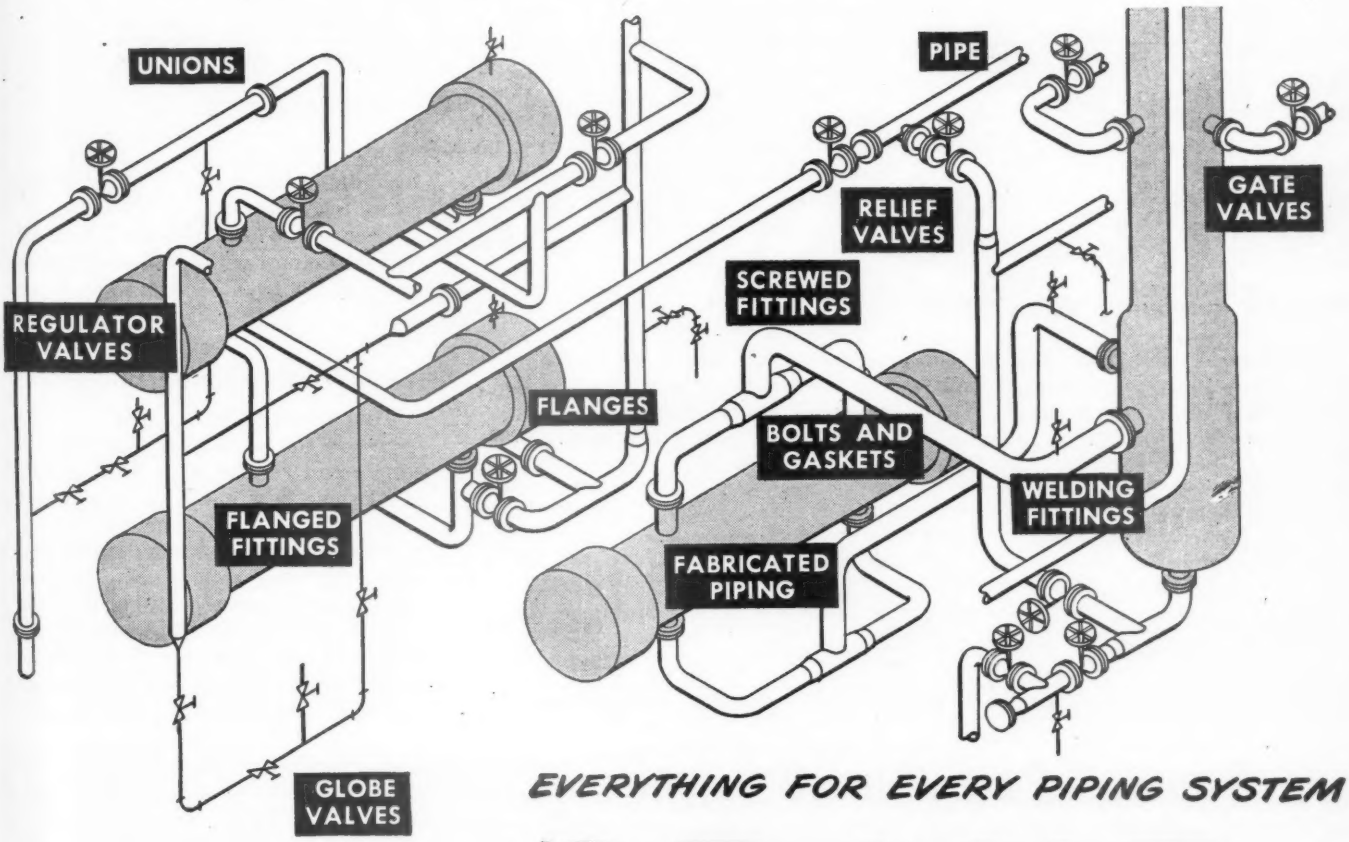

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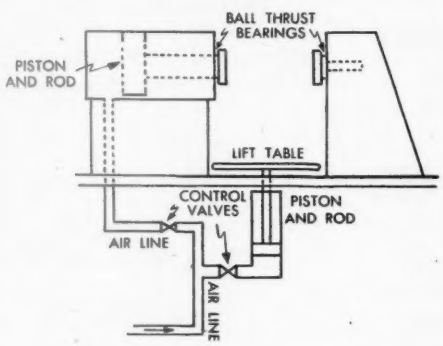
Pneumatic Vise for Holding Valves for Repair

For holding railroad car airbrake valves and similar equipment for working on the unit, an air-actuated vise is made. A fixed jaw support is bolted firmly to the top of a workbench at the desired location. In the inside vertical face of this jaw support a fixed jaw, having ball thrust bearings between it and its support, is installed, the jaw being of the desired size and shape, both depending on the sizes of equipment to be held in the vise.

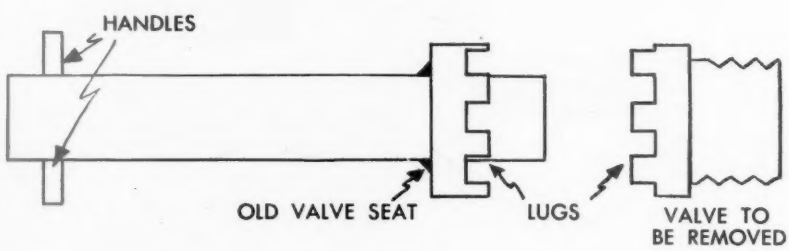
At the required distance from this fixed jaw a 3-in. air clyinder is supported strongly opposite to and at the same level as the fixed jaw. A piston is fitted to this cylinder, and a rod extends through the packing gland on the side toward the fixed jaw. On this rod is fitted a jaw similar to the one fitted to the fixed support, equipped also with ball thrust bearings. The end of the cylinder farthest from the movable jaw is connected by a pipe of the required size with a source of air pressure, the pipe being fitted with a valve, which may be a 3-way valve to permit either inlet of air to operate the piston or to exhaust the air from the cylinder to the atmosphere when the vise is to be opened. Through the top of the workbench or other support for the assembly a rod extends: this rod passes through a smaller (1⅜-in.) cylinder that is fastened to the underside of the table or bench and a suitable piston is fitted to the rod end in this cylinder. On the upper end of the rod a plate or 'table' is fitted, on which the work may be placed. The cylinder is connected to an air supply also, with a valve for control as is used in the movable jaw assembly.



By admitting air to the table cylinder after the unit of equipment is placed thereon, the work is raised to the desired height between the two jaws described first. By shutting off the valve the work is held in place. The air is admitted to the movable jaw cylinder and the work is fixed between the jaws, ready for the work to be carried on.—(P. C. Koger).

Tool for Removing Valve Seats

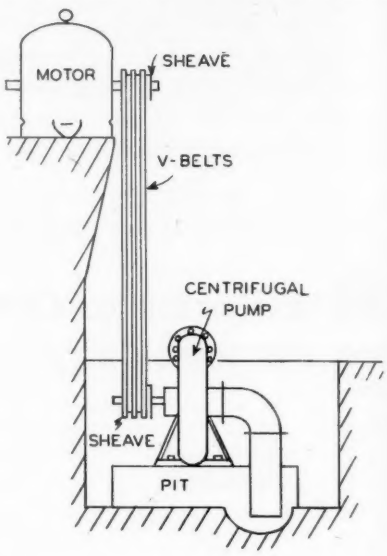
Removal of valve seats from Copes boiler feedwater regulators offers considerable difficulty on occasion. The tool shown in the drawing is a handy one for removing these seats quickly and efficiently. In making the tool, an old valve seat is slipped over a 16-in. length of 2-in. pipe, with the valve reversed so that the lugs point toward the near-end of the pipe, and is welded into place so that the pipe section beyond will slip into the valve seat to be removed, and engage the lugs of the old valve with those of the one being removed. On the 'long' end of the section of pipe and guide and handles are welded, handles of the length desired for holding and handling the tool. In use the end of the tool holding the old valve seat is slipped into the seat to be removed until the opposing lugs engage; a pipe wrench may be used then on the tool handle to loosen and unscrew seat.—(Gieger).



Pumping From a Pit

One of the important advantages possessed by the V-belt is illustrated herewith. The engineer installing the pump in the pit did not want to use a direct-connected motor for fear the pump might leak and flood the pit, or something else might happen to flood the pit, as often happens with pits.

Therefore the motor was placed in a high and dry location, well above the pump, and was connected to the pump by V-bents.

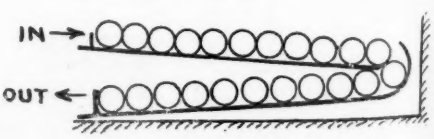


Now, in the event that the pit should flood the motor will not be endangered and will not even become wet.

—W.F.S.

Water-Tight Expansion Joint

The water-tight expansion joint shown in the accompanying sketch is simple and can be made in most any plant shop. It is made up of a rubber ring, clamped between an outer set of copper rings, and an inner set of steel rings, the inner rings having the free edges bent inward to avoid chafing the rubber. The copper rings outside are male and female, with a sliding fit to protect the joint, and to make it more resistant to side motion. Other flexible materials than rubber can be used which will give longer service especially with chemicals, steam, or liquids with solvent action on rubber.—WFS



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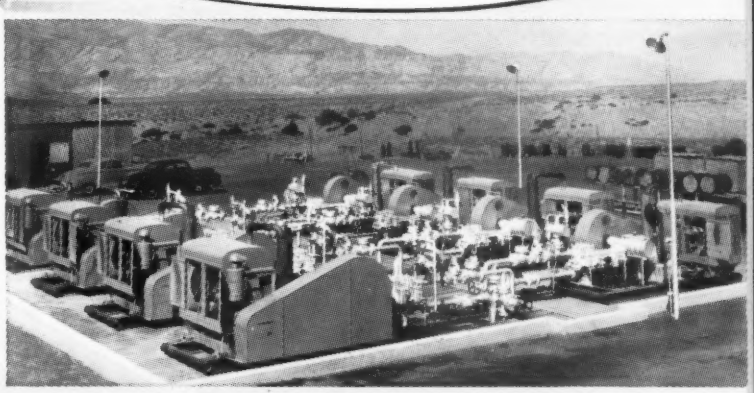

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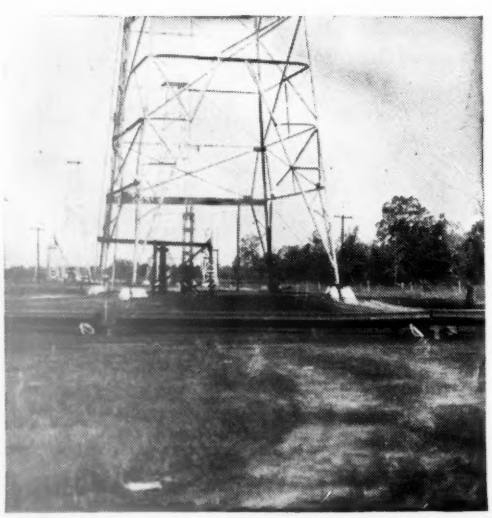

Barrett offers an expert supervision service in connection with application plants and yards. Owners wishing to avail themselves of the advantages of professional application can have the work done with Barrett materials and under Barrett supervision. We will be glad to supply further information upon request.

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The Astounding Cost of Corrosion

ELSEWHERE in this issue of *The Petroleum Engineer* there appears a news story telling of plans for a four-day school to give practical training in corrosion control to pipe line superintendents, foremen, engineers, and inspectors. The school is being sponsored by the Tulsa Section of the National Association of Corrosion Engineers.

To those in the pipe line industry, as well as the entire petroleum industry and numerous other industries, the fact that corrosion exists in astounding degree is not, of course, unknown. The true enormity of the loss occasioned, however, may not be fully realized by some.

One authority, making a study for NACE, has arrived at a figure of approximately $5,500,000,000 (billion) as the annual loss in the United States caused by corrosion, including the cost of corrosion control. This is termed a direct loss. There are also many indirect losses, such as lost time of workmen due to accidents, loss of products, etc. The figure given here, to be sure, is not confined to the pipe line industry, nor even to the petroleum industry as a whole, but is for all industries utilizing materials that are subject to corrosion. It does, however, point up in an arresting manner the ravages that occur through this medium.

Getting closer to home, it is cited that an estimated $600,000,000 is the annual cost for underground pipe maintenance and replacement. Included in this are water lines, but approximately 75 per cent of the total can be charged to gas, oil, and products pipe lines. Additionally, losses to tankage and pumping equipment, which are *not* included, run into many more millions of dollars annually.

The National Association of Corrosion Engineers has been the leader in the fight on corrosion. That is the reason the association was organized, and the school announced by the Tulsa Section is another forward step in this program. The Tulsa course should be of especial value because it will give training to those responsible for carrying out properly the protective programs authorized by management, and the knowledge thus gained will equip them to discharge their task efficiently.

J. H. Love

Master has now completed its No. 2 PIPE MILL

No. 1 Pipe Mill is equipped to produce pipe using the *press method.* No. 2 produces pipe using the roll process. Master can now handle two separate contracts at the same time, producing two diameters of Master Hi-Test Expanded Line Pipe in sizes from 20" through 36" in 30' to 31½' sections.

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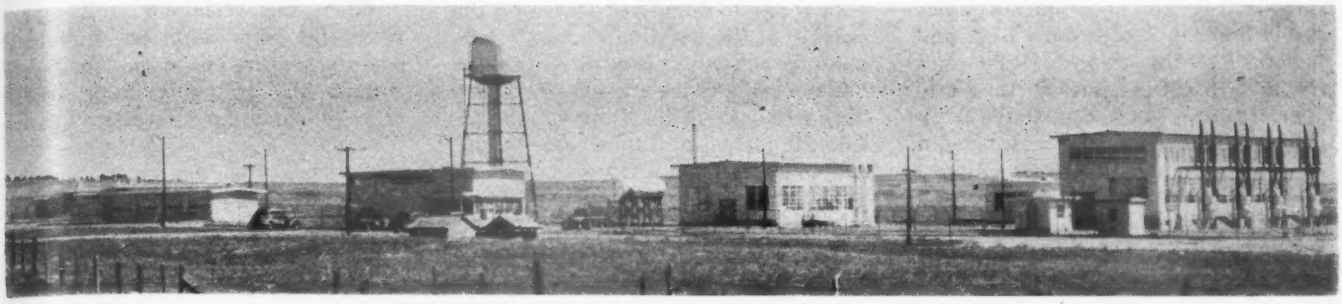


General view of Colorado Interstate Gas Company's McClintock station.

MODERN STATIONS

Long Range Planning Avoids Obsolescence

H. F. DAWE* and H. N. WADE*.

THE McClintock station of the Colorado Interstate Gas Company embodies many of the latest ideas in construction, design, housing, and decoration. It is situated about 13 miles east of Colorado Springs, Colorado, at the edge of the Black Forest and at an altitude of 7000 ft. Although this installation was completed in May 1946, there probably is no more modern compressor station in main gas transmission line service. It is a most excellent example of what long range planning can do to prevent an installation from becoming outdated.

The station is designed as a peak load unit in the Colorado Interstate pipe line system and generally supplies natural gas to consumers north of Colorado Springs, in Denver, and as far as Cheyenne, Wyoming. The load conditions vary from about 75,000,000 to 100,000,000 cu ft per day at a pressure base of 14.65 psi. The suction pressure of the station varies from 200 to 300 psi, depending upon the line pack conditions.

The main line of the Colorado Interstate Gas Company at the station is 20 in. in diameter and is designed to handle a maximum of approximately 100,000,000 cu ft per 24 hr, operating at a pressure of approximately 400 psi.

A resumé of some of the engineering details follows.

*The Stearns-Roger Manufacturing Company.

Piping

The engineers responsible for the design of the piping have felt that the cross-country pipe line standards set up in Section 2, Division 2, of the ASA "Code for Pressure Piping," are inadequate for safe application to piping in compressor plants, even though the above section of the code permits carrying the cross-country piping standards into the compressor stations, provided such stations are outside cities or villages or closely populated areas. Instead of following this section of the code, it was decided to follow the much more rigid standards of Section 3 of the same code, using the standard set up in this section for oil and gas piping inside refinery limits. Extensive use of this latter section of the code over the past five or six years in the design of compressor plants, particularly for unusually high pressures ranging from 2500 to 4000 psi, has indicated that the heavier wall thicknesses called for by this section are necessary in order to withstand additional stresses imposed by vibration and temperature changes in piping immediately surrounding the compressors themselves. This standard was followed throughout the gas piping from the plant inlet to the outlet.

Valves

Lubricated plug cocks only, of the proper ASA specifications, are used in all gas service. Experience indicates that such plug cocks give highly satisfactory service for handling gas from the standpoints of easy operation and reliably tight shut-off. Worm or spur gear operated plug valves are used in gas service for pipe sizes 6 in. and larger.

Dust Scrubbers

As the station operates on a gas line that has been in service for a number of years, it was not considered necessary to provide dust removal devices ahead of the compressors. The compressors take suction directly from an 18-in. pipe header, which is a side outlet from the main gas line. The compressors discharge into an 18-in. pipe header and into the 20-in. main line; 18-in. suction and discharge headers are separated at the main line by a 20-in. block valve.

Compressors

There are four 800-hp compressors installed, and provision has been made to extend the installation to six engines. These machines are placed in a 110-ft long by 30-ft wide by 24-ft-7-in. eave height fully insulated metal covered, steel frame building. The buildings are of special design and quite modernistic in appearance. There is a full basement provided that is utilized to house all the required utility piping, the oil reclaimers, dirty oil tank, and other items that may be conveniently placed in the basement.

EXCLUSIVE

The starting air lines, jacket water supply lines, lube oil supply lines and reclaimed oil lines, and fuel gas lines are included in the lines in the basement. There is an access stairway to the basement from the main compressor floor situated between engines No. 2 and No. 3. There are also two outside stairways, one in the center and one at one end of the basement. The compressor discharge and suction lines are run out of the building along the ceiling of the basement, to buried headers outside the north wall. There are no header loops or expansion bends, except that the depth of burial is such as to provide an adequate expansion arm.

The compressors are mounted on reinforced concrete blocks, which in turn are dowelled to a continuous reinforced concrete mat that extends over the whole building area to provide a very rigid and stiff base and generous soil bearing surface.

One air cleaner and two uninsulated exhaust silencers are provided for each compressor. The air cleaners and exhaust silencers are all supported from structural steel frames. The silencers are mounted above a pipe tee on the side outlet of the tee. The run of the tee is provided with a blowout head. There are no backfire relief valves on the air intakes. The exhaust pipes are jacketed and are provided with separate dampered stacks on the outside of the building to control the amount of hot air vented. Closing a damper reduces the amount of cooling air carried along the exhaust pipe inside the jacket, and thus causes more heat to be radiated inside the building. This reduces the building heat load in cold weather.

The compressor engines are placed in a single row with the crankshafts parallel to the axis of the building. The engines all have magneto ignition systems. Gas is compressed from 200 to 400 psi in four cylinders per machine.

Oil System

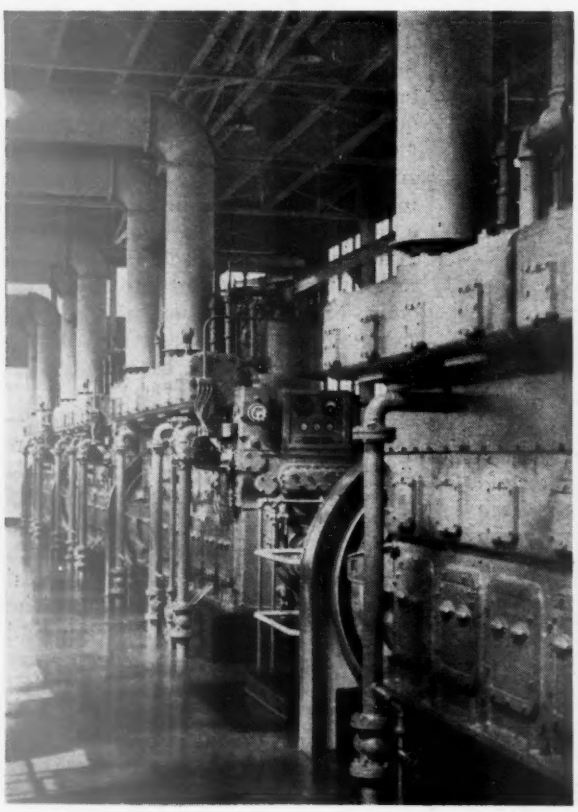
One oil reclaimer unit is installed in the basement of the compressor building. This unit is so connected that it may take suction from the crankcase of any of the four compressor engines in the compressor building individually, and the reclaimed oil may be returned only directly to the crankcase of the unit from which it is being withdrawn. A line with locked valves permits draining any crankcase into the dirty oil tank in the basement. A pump on the reclaimer delivers cleaned oil to a reclaimed oil tank mounted in the truss structure of the compressor building, from which it can be drained through a piping system into any engine.

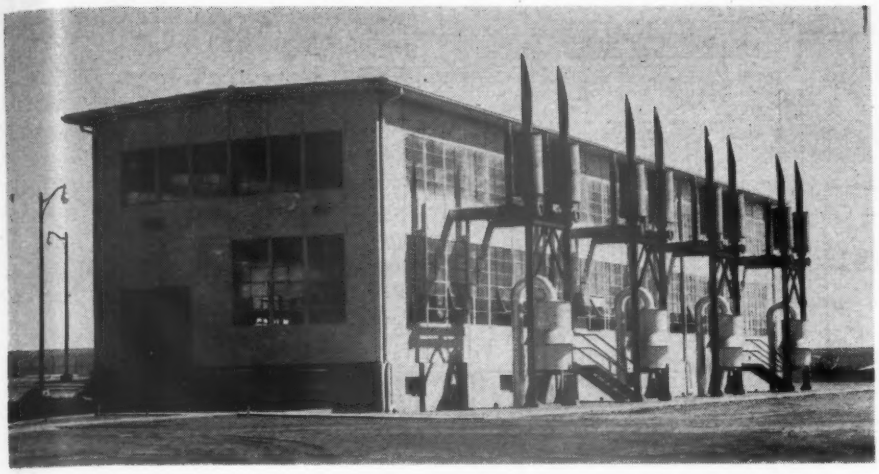
When the reclaimer unit is not reworking oil from an individual compressor engine it is possible to reclaim the accumulated oil in the dirty oil tank. This oil is sent to the reclaimed lube oil tank in the compressor building. There is no separate reclaimed oil unit provided for the generator engines. Oil from the generator engines is handled by the oil reclaimer unit in the compressor building. The lube oil makeup to the generator engines is always fresh oil.

A 9025-gal, 8-ft by 24-ft lube oil tank is provided for the station supply. There are two small positive displacement pumps in the auxiliary building for handling lube oil makeup to the generator and compressor engines. The lube oil pumps discharge into a pressure tank in the generator building against the air that is contained in the tank. The pressure in this tank actuates a pressure switch that automatically starts and stops the lube oil pumps so that there is always oil under pressure in this makeup tank. The oil is pressured from this tank through pipe lines to dispensers in the compressor and auxiliary buildings.

Just ahead of each dispenser there is a positive displacement meter for measuring the amount of makeup oil that is used. It is possible through three-way valving to dispense any

Interior views of compressor room where four 800-hp compressors have been installed and provision made for two more.





Compressor building showing mufflers and air cleaners.

amount of oil into hand measuring cans or to force makeup lube oil directly into the crankcase of the engine. In either case, the total amount of fresh oil used is recorded. There is no record kept of the amount of reclaimed oil. The packing gland vents, drains from the compressor cylinders, and drains from the dispensers are carried to the dirty oil tank in the compressor building basement for reclaiming, thus avoiding a considerable loss in lube oil.

Gas Cooling

In the compressor station there is no gas cooling. The discharge gas from the compressors goes directly into the main pipe line. In the winter, when the station is at peak load conditions, the ground temperature is so low that the gas is cooled in the main pipe line without any appreciable effect on the capacity of the pipe line. The omission of gas coolers reduced the cooling equipment required by the station, and has resulted in further economies in piping, valving, and instrumentation.

Jacket Water and Oil Cooling

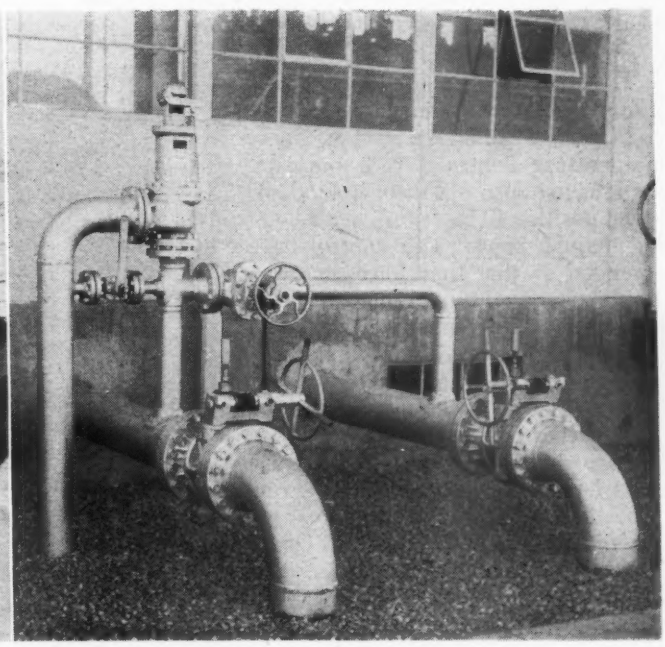
The cooling equipment is confined to cooling for the jacket water and the oil. There are two separate circuits of cooling water, as shown in the cooling water flow diagram, Fig. 1. In the main cooling water system, or hot circuit, the engine jacket cooling water enters the engine jackets at an inlet temperature of approximately 140 F and reaches a temperature of 150 F at the outlet of the engines. This water flows to a hot well where it is picked up by the hot jacket water system circulating pumps and forced through a jacket water cooler, and thence through the engines. The jacket water cooler is a dry, or radiator, type cooler with two-pass sections. It has a cooling duty of 2090 gpm of jacket water from 150 to 140 F. It is equipped with two 25-hp two-speed fans, which drive cooling air through the sections.

The secondary, or "cold," water circuit provides cooling for the oil coolers and the compressor cylinders. The pump on this circuit takes suction from the cold jacket water well and discharges the jacket water through two evaporative type coolers. Each of these coolers has a capacity of 174 gpm of water, cooling from a temperature of 110 to 100 F with a 60 deg wet bulb. Each unit has a 5-hp fan motor with belt drive, a spray section with spray nozzles and spray eliminators, a drip pan with full float valve control, and an individual circulating water pump driven by a ½-hp motor. These units have been very effective in handling the cold jacket water requirements of 346 gpm.

Difficulty in obtaining adequate water at this plant location is primarily responsible for the choice of dry cooling for the hot jacket water system. There is insufficient water in

Compressor building showing suction and discharge piping.

Closeup of suction and discharge piping showing relief valve and bypass arrangement.



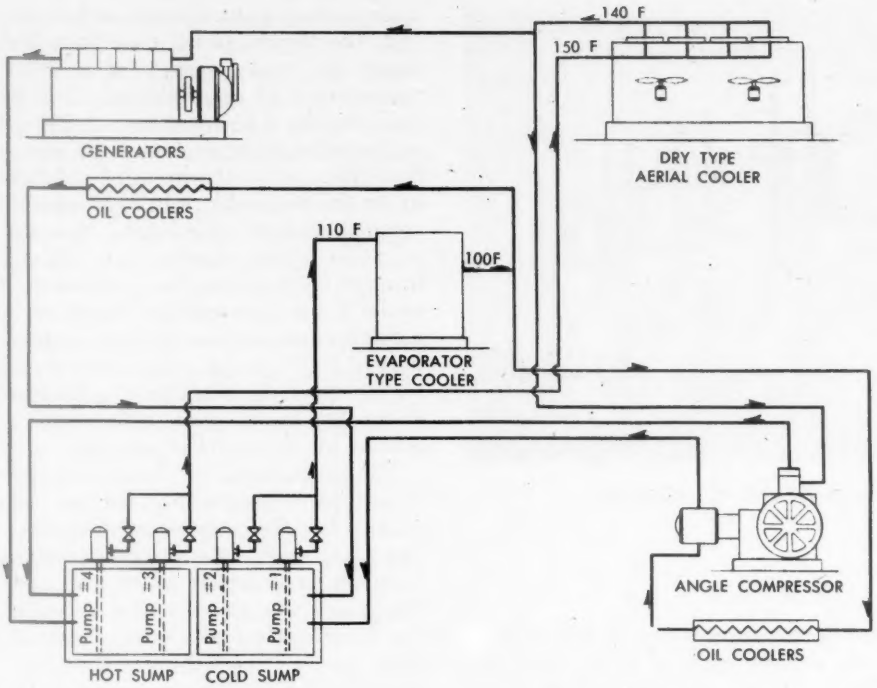


FIG. 1. Diagram of the McClintock station.

this locality to maintain a cooling tower large enough to handle the entire plant cooling load without undue expense for wells, while atmospheric conditions are satisfactory for operation of dry cooling. There is sufficient well water of good quality to provide jacket water makeup, water for the small heat load on the evaporative cooling, boiler water makeup, and water for domestic purposes. In the winter, during peak load conditions, the dry cooling on the hot jacket water system has been adequate in all cases and even in excess of the actual requirements, while due to the reduced load, the same system still affords ample jacket cooling during the rather warm summers.

The hot jacket water system coolers are provided with temperature controls on the outlet water side. These temperature controls start and stop the fans and also put them in the half-speed position in case of reduced cooling requirements. The controls are arranged so that they have an overlapping temperature range through proper relays, arranged so that when both fans are operating No. 1 fan will drop to half speed while No. 2 is at full speed; then if the temperature of the jacket water drops further, No. 2 fan drops to half slow position and No. 1 fan drops from half speed to off. Continued additional cooling causes the No. 2 fan to drop from half speed to off. When the temperature rises, the fan speed cycle is reversed.

To control further the engine jacket water temperature, a temperature-controlled bypass valve is connected across the inlet and outlet water headers at the jacket water cooler. The temperature bulb of the instrument controlling this valve is responsive to the temperature of the water entering the engine jackets. Too cold outlet water temperature causes the bypass valve to open, decreasing the cooling, and vice versa. A thermostatically-controlled air damper arrangement is used to control the temperature of the water on the cold system through the evaporative coolers, by partially by-passing heated air back into the air inlet.

The jacket water circulation rate is designed for a temperature rise of 10 F through the jackets.

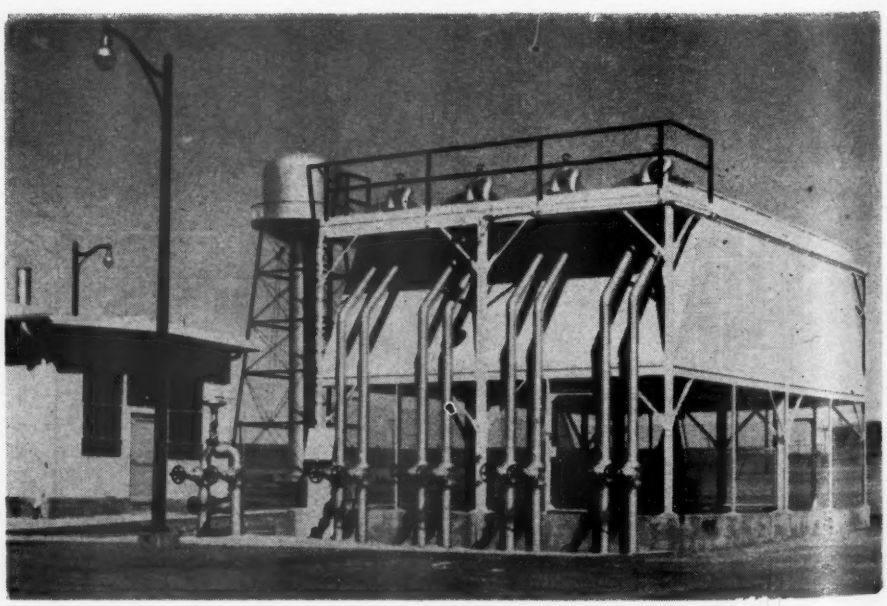
In the cooling water sumps in both hot and cold wells, regular duty and spare pumps are provided. Piping is sized and space is provided for a future third pump in each sump, in case the station is increased to the ultimate of six engines.

Electric Power System

The electric power for the station is generated by two 4-cycle, 210-hp (at sea level rating) 600 rpm, 9-in. bore by 10½-in. stroke gas engines, each driving a generator rated 125 kw at 0.8 power fatcor, 3-phase, 240-volt, 60-cycle, with a 5-kw, 125-volt exciter mounted on the generator frame. The generators for all units are the standard open frame engine type rated for a 40 C rise. Each generator unit has a separate fuel gas regulator and is supplied by an 8-in. by 84-in. fuel gas reservoir. Each engine is equipped with an exhaust silencer, and intake air is cleaned by an air cleaner with backfire relief valve. The exhaust jackets on the generators are handled in a manner similar to those on the compressors, with stacks and dampers to control the heat released in the building. Generators feed electric energy directly to a bus system in a control and distribution center that is fully enclosed. From this center electric power is distributed to all parts of the plant.

The switchboard has breakers for the circulating water pumps, air com-

Hot jacket water cooler.



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OUTPERFORMS IN ANY GOING Easily pulls heavy equipment — like bending machines — up steep grades and through soft going. The torque converter drive automatically synchronizes HD-19's speed with the equipment being pulled or pushed — no shifting. An important advantage when working with cleaning and priming or doping and wrapping machines!

OUTMANEUVERS Shifting is practically eliminated — only two forward gear ratios — 0 to 3 and 0 to 7 m.p.h. Operator just "guns" the throttle when pipe is lowered-in, gets in front of other tractors in a hurry and quickly maneuvers into position. Steering is hydraulic . . . braking is self-energizing — no tiresome pulling and pushing of levers and brakes.

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10 ALLIS-CHALMERS TRACTORS — six HD-19's and four HD-10's — help keep pipe-laying moving fast for Midwestern Constructors — contractors on schedules No. 4 and No. 5 of Transcontinental's 1,850-mile job from southern Texas to New York City. Shown are three of the HD-19's lowering-in pipe at Newnan, Georgia.

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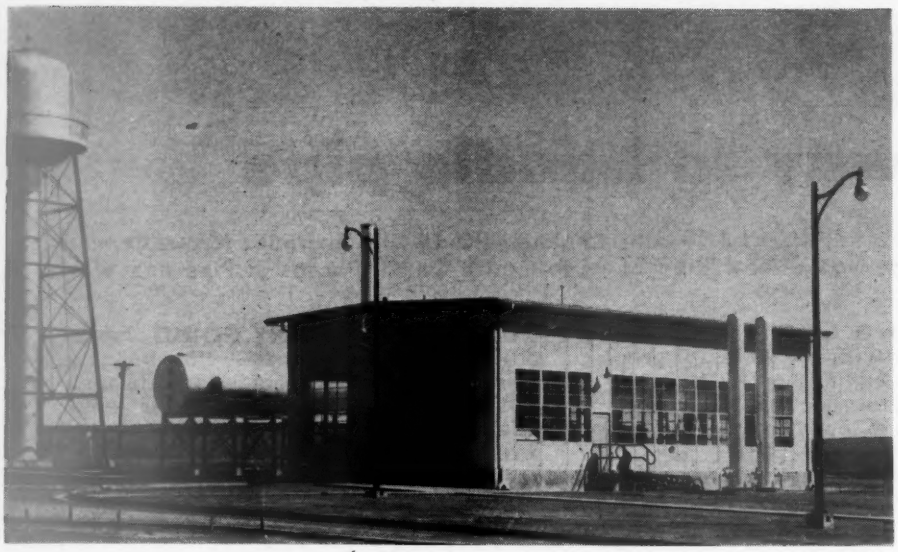
There's a right size A-C tractor for every need

Model	Horsepower	Weight (bare)
HD-19	163.00 on flywheel	40,000 lbs.
HD-10	86.63 drawbar	21,000 lbs.
HD-7	60.10 drawbar	13,830 lbs.
HD-5	40.26 drawbar	10,500 lbs.

Originator of the Torque Converter Tractor



Generator building showing air receivers.

pressors, dry type cooling unit fans, evaporative cooling units, and other power items. Adequate spare circuits are provided for future installations.

Electric generation voltage of 240 volts was chosen at the request of the owner, since the owner had the same generator voltages in existing stations and desired to maintain uniformity in the installations. A four-wire grounded neutral electric lighting system was used to supply 110-220 volts.

The generators are housed in a 60-ft long by 36-ft wide by 14-ft (to truss line) fully insulated, metal covered, steel frame building. This building also serves to house the heating boiler for the compressor station, the electric motor driven starting-air compressor, the gasoline engine driven emergency air compressor, the electric switchboard, the lube oil pressure tank pumps, and also provides enough space for a 12-ft by 14-ft change room and 22-ft by 12-ft shop space. Space has been provided in this building for the addition of a future generator.

Water Supply

The station water supply is from deep wells that have been drilled in the vicinity. The well pumps are designed to pump into an elevated water storage tank. This tank is a 20,000-gal double ellipsoidal unit, elevated 60 ft to the tank proper. It has a 30-in. standpipe.

Fuel Gas System

The fuel gas to the station enters a 2-in. meter run and then passes to a pilot operated primary fuel gas regulator where the pressure is reduced from about 300 psi to 50 psi. The gas from this regulator enters a volume chamber that is protected by a relief valve, and passes thence into a sensitive regulator that reduces the pressure to 25 psi. Both regulators are duplicated by regulators in parallel; either will handle the fuel requirements for the compressor station. Each of these regulators is designed to close upon failure of its pilot, while the other then takes the full load of the plant. The generator fuel gas regulator is a sensitive type regulator that drops the pressure from 25 psi to 1 psi into the gas reservoirs at the generators. This regulator also is duplicated. The fuel gas to the boiler also is handled through a sensitive regulator that drops the pressure from 25 psi to about 1 psi. This regulator is duplicated to insure continuous service on the heating system.

The compressor fuel header is supplied directly from the second reducing regulators at 25 psi, and the individual machines do not have individual regulators. A large main fuel gas header is installed, so that each compressor is provided with ample fuel volume to smooth out surges.

The fuel gas regulators and meters are housed in a 10-ft by 12-ft by 8-ft eave building that matches other structures at the plant.

Heating System

Heating for the station is provided by a 75-hp, 15-psi working pressure steam boiler. This boiler is installed in the auxiliary building. From this location there is a steam supply line to the compressor building. The compressor building steam header serves to supply the steam for the fuel gas and regulator building and for the oil cooler building. There is a second main from the auxiliary building to the office and warehouse. All steam piping and return condensate is carried in insulated underground steam mains. The boiler is served by a condensate return unit, which has its own makeup control, return tank for controlling makeup water, and a pump for charging boiler feed water. This unit is installed in a sump in the auxiliary building adjacent to the boiler.

Other Buildings

The station has a combination office and warehouse building made to the same general architectural specifications as the other buildings. The evaporative type coolers for the cold jacket water system are housed in a similar type small insulated building.

Two residences have been provided at the station for housing station personnel. They incorporate the latest and most modern conveniences and are modernistic in architecture. Each residence has a full finished basement that provides extra living accommodations for personnel in the event the station becomes snowbound.

The Colorado Interstate Gas Company has put into effect extensive plans for landscaping the grounds of the station and residences to carry out its program of making this compressor station a complete, attractive installation.

Painting Program

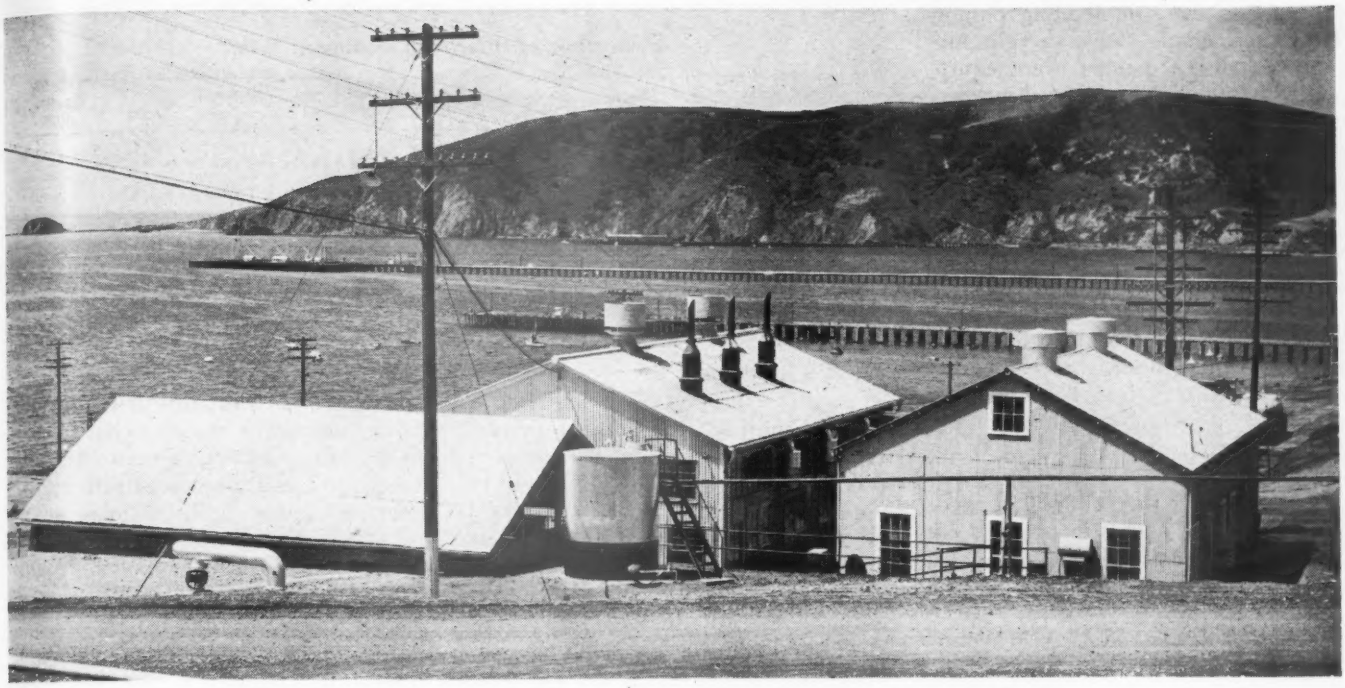
Perhaps the most outstanding thing visually is the decorative scheme of painting used in this station. The painting program conforms with the scheme adopted by the company for all its compressor plants and was worked out with Pittsburgh Plate Glass Company. The scheme of painting incorporates newest ideas of visibility, eye restfulness, and general color psychology.

The station was designed and constructed by the Stearns-Roger Manufacturing Company as engineer-contractor, in collaboration with the Colorado Interstate Gas Company.

* * *

French Builder Working On Two Supertankers

Work has already begun on the construction of two supertankers of 31,285 dwt, the *Berenice* and *Bethsabee*, at the Penhoet yard of St. Nazaire for Cie Auxiliarie de Navigation of Paris, it is reported. These tankers will be fitted with diesel engines of the B. and W. type, and the main motors, being made at St. Nazaire under license to Burmeister and Wain of Copenhagen, will total 13,600 ihp to give the tanker a service speed of 15 knots.



General view of the plant with piers and dock showing in the rear distance.

Modernizing a Marine Oil Loading Plant

RICHARD SNEDDON*

THE modernization of Union Oil Company's tanker loading facilities at Avila, a tiny village on the California coast, about 10 miles southwest of San Luis Obispo, converts one of its oldest marine terminals into an up-to-the-minute station with a loading capacity of 20,000 bbl an hr, and an operational flexibility that greatly increases the usefulness and efficiency of the entire port. As proof of these latter statements, loadings of a single commodity have been accomplished at rates in excess of 20,000 bbl an hr, and shortly after its renovation the plant loaded five different commodities—a total of 303,563 bbl—into three ships in 29 hr, 35 min, including the time required for line clearances and all other essential operations. This means the total elapsed time from the moment the first vessel dropped anchor until the last one weighed anchor at the conclusion of the loading schedule. The actual loading time was 24 hr, 25 min, or the equivalent of 12436.2 bbl an hr, which is especially good when it is noted that the cargoes were predominantly heavy oil—the percentages being 61.9 per cent heavy and 38.1 per cent light. Details of the operation are shown in the accompanying table.

The Avila terminal has long received crude oil from various coastal fields, largely in the Santa Maria-Orcutt area, through two trunk lines, and has similarly received production from the San Joaquin Valley through another pair of lines. This oil, which has been stabilized and dehydrated where necessary prior to receipt at Avila, is then shipped by tanker to Union Oil Company refineries either at Wilmington in the south, or at Oleum on the Craquinez Strait near San Francisco. It is almost 40 years since the original pumping station was built adjacent to the small Avila refinery, and approximately a mile from the loading dock. Prior to the completion of the improvement program described here, ship loading was performed by two steam turbine-driven centrifugal pumps, the steam being generated in four 300-hp gas-oil fired boilers. The recent changes made at the station have permitted bulk movements of crude oil in about two-thirds of the time formerly taken, and with a substantial fuel saving in the range of 80 to 90 per cent.

The cost of the changeover was about $1,250,000, and included the replacement of the two steam turbines with gas-diesel engines as the power

*Pacific Coast Editor.

EXCLUSIVE

for driving the ship loading pumps. The latter, single stage, double suction, centrifugal pumps, were equipped with 3.96 to 1 high speed increasers to loft the rpm from 450 to 1780. A third gas-diesel engine and centrifugal pump were installed, and a 20-in. suction line was added for the handling of Santa Maria type crude. The engines, incidentally, are 6-cylinder 12-in. by 15-in., 460-hp units at 450 rpm. They are provided with a dual fuel system, and can operate either on diesel or gas-diesel, without changing the injection system. These engines were especially designed for maximum efficiency under the variable load and variable speed operating conditions that are normally to be found at such pump stations. They are believed to be the first of their type used in a marine loading plant on the west coast. At the Avila station speeds vary from 325 to 450 rpm, and the load also varies from one-fourth to full load in intermittent use.

The engines are first started on diesel fuel. Gas is then introduced into the air passage, and the combustible mixture is so distributed that the cylinders are in proper balance. This uniformity is accomplished by adjusting a needle valve on each individual cylinder until all exhaust temperatures are in close agreement. The proportion of gas to diesel fuel employed is approximately 9 to 1 at full load. Only the initial proportions of the two components are a matter of choice. Thereafter, the governor automatically adjusts the ratio to that which will give maximum performance at the prevailing speed and load, and controls are so designed that the requisite quantity of fuel for full load conditions cannot be exceeded.

Jacket water cooling on the engines is contrived by radiators driven by gas power units. The radiators have automatic air shutters, thermostatically controlled, and additional safety precautions consist of an automatic shut-off system that takes effect when jacket water temperature becomes too high, lube oil pressure too low, or excessive engine speeds develop.

The improvements at the plant have increased the loading rate by more than 3000 bbl an hr to a maximum in excess of 15,000 bbl for Santa Maria crude. A 15,000-bbl rate is assumed to be the limit at which Santa Maria crude can be loaded safely on a tanker at Avila. With this increased loading rate, however, the port facilities are

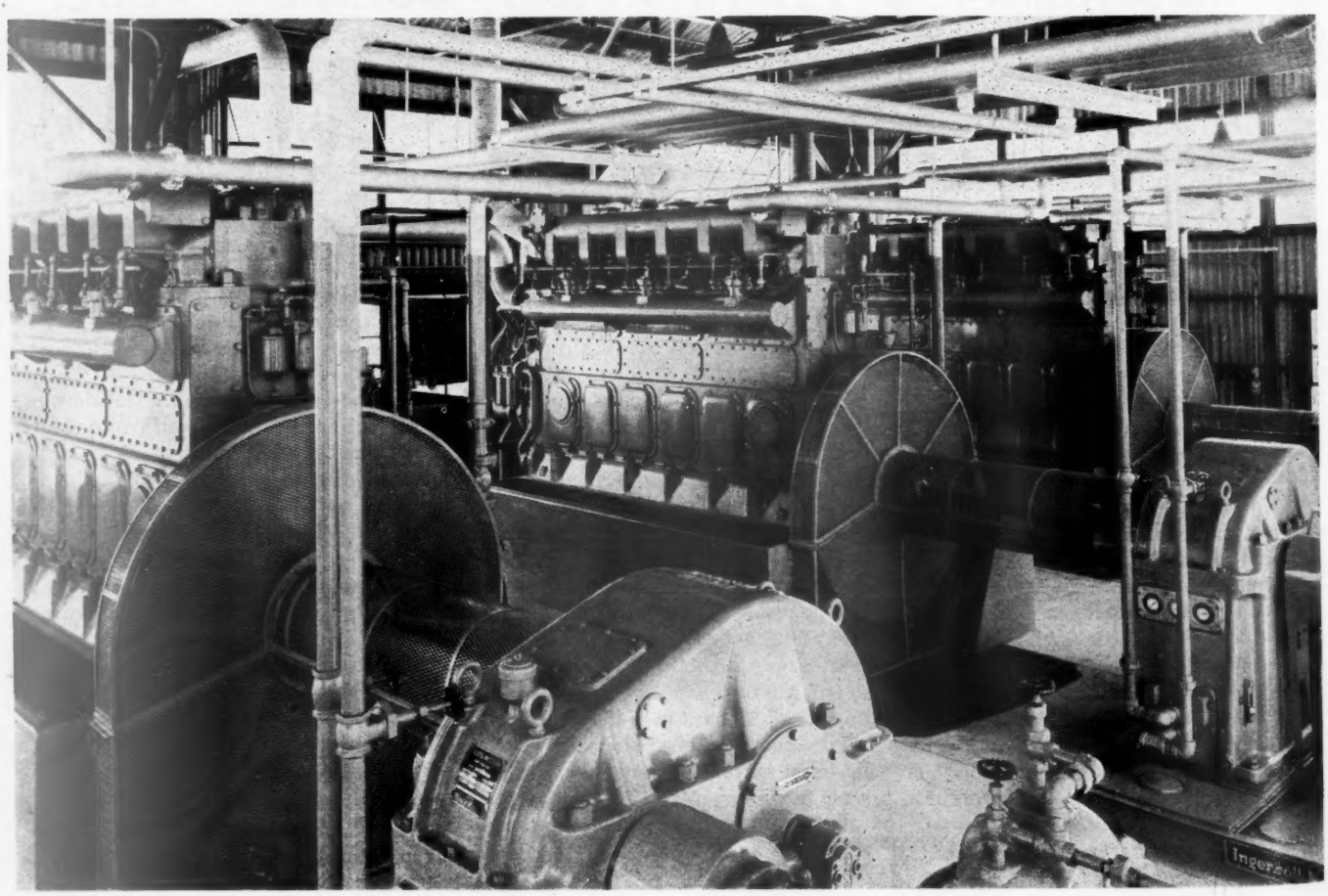
Particulars of three-ship loading at Avila.

Vessel	Docked	Began loading	Commodity	Quantity loaded	Gravity	Finished loading	Sailed	Loading time
								hr — min
Lompoc.....	1:35 a.m.	1:55 a.m.	V.R.C. O.E.C.	69,790 bbl 45,787 bbl	32.4 & 25.7 28.0	10:30 a.m.	11:20 a.m.	8 — 35
S. Paula.....	10:40 a.m.	11:05 a.m.	S.J.V. H.C.	105,971 bbl	15.1—15.4	7:10 p.m.	8:00 p.m.	8 — 05
L. P. St. Clair	9:20 a.m.	10:15 p.m.	Poso S.J.V. H.C.	31,601 bbl 50,504 bbl	14.9 15.8	6:00 a.m.	7:00 a.m.	7 — 45
Totals.....				303,653 bbl				24 — 25

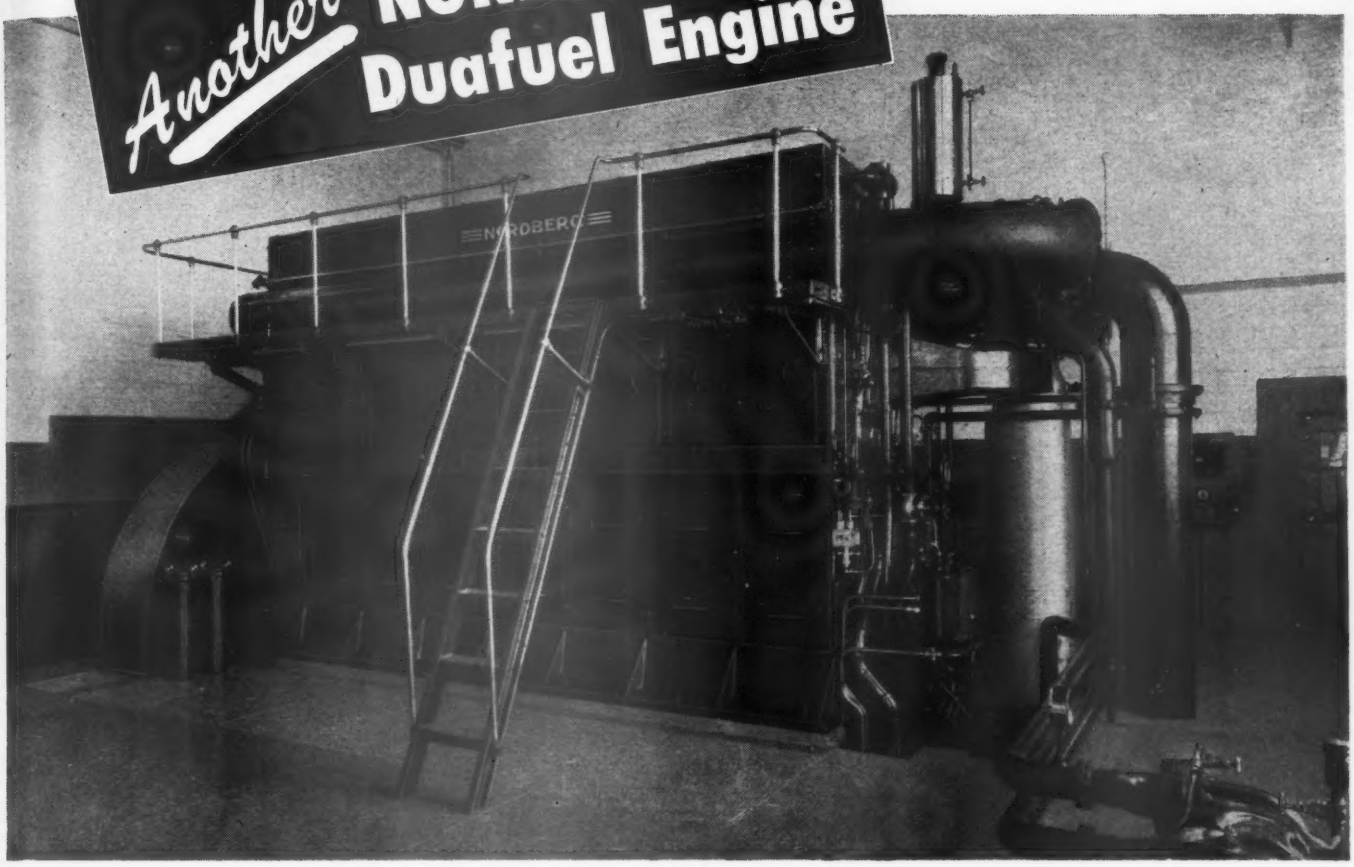
First vessel docked until last vessel sailed—29 hr, 35 min.

PHOTOS COURTESY ENTERPRISE ENGINE & FOUNDRY COMPANY

Three-quarter shot of the engines showing the gas manifold, the step-up gears, and the centrifugal pumps.



Another NORDBERG Duafuel Engine



. . . furnishing dependable Pipe Line Pumping Power

For main line or booster stations—wherever you must keep petroleum products on the move with plenty of power—you can count on Nordberg Diesels of the right size and type to do a dependable, economical job, day-in, day-out.

Available in a power range from 150 horsepower upward, scores of these rugged engines built by Nordberg and its Busch-Sulzer Division have been proved in over 25 years of pipe line service, in a wide variety of requirements ranging from self-contained portable pumping units for gathering lines to permanent trunk line stations and generating units for station power and lighting. For complete details, write for Bulletins.

Nordberg Engines are built in two and four-cycle models in a wide range of sizes from 10 to 8500 H.P., including Crude Oil and Gas Burning types.

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Four-Cycle Diesel Plant—BUSCH-SULZER DIVISION
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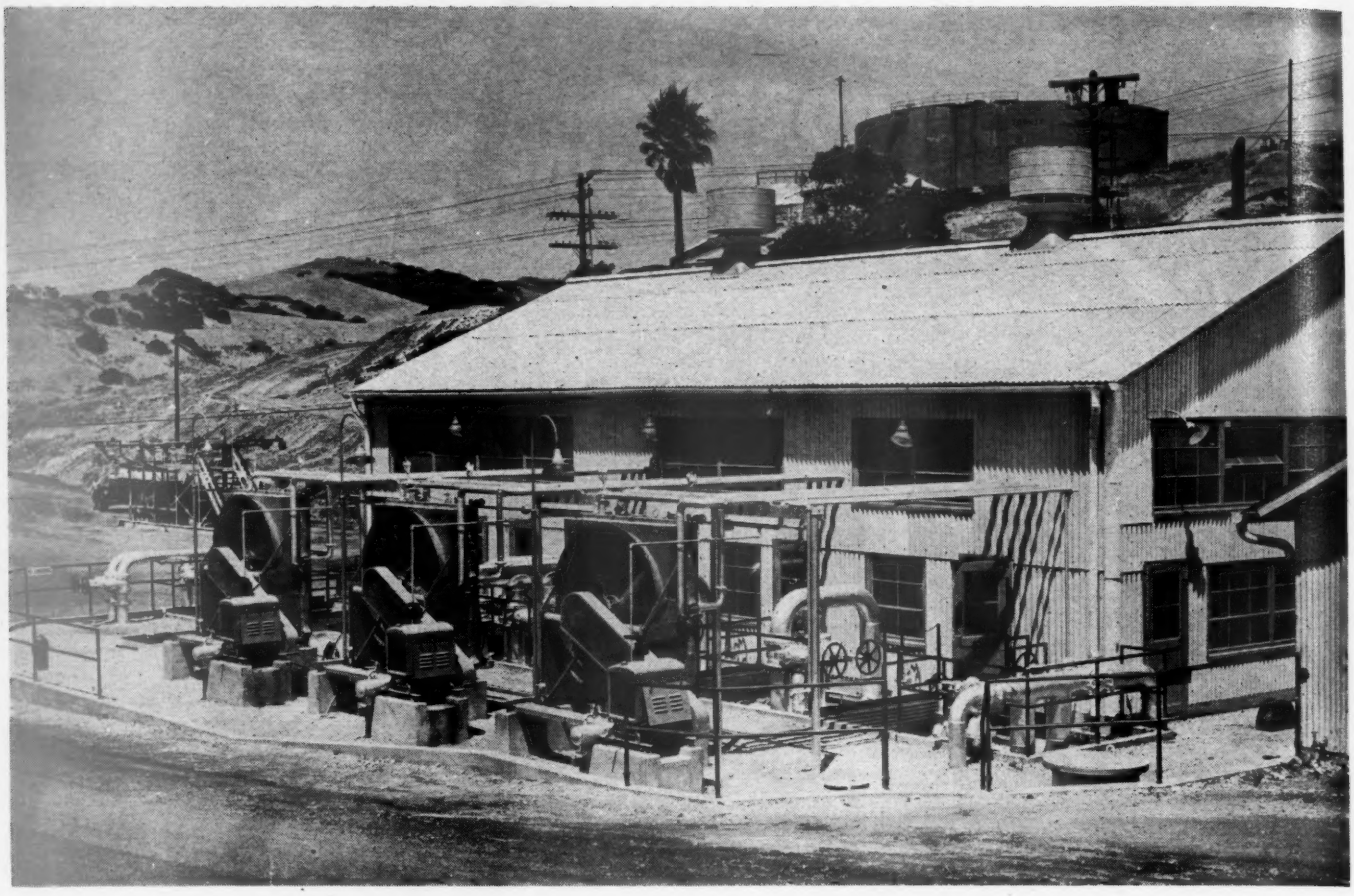
NORDBERG MACHINERY



External view of the pumphouse showing the three radiators and the main oil piping manifold.

able to load heavy crude through a 16-in. line with two pumps at 8500 bbl an hr, while light crude is being pumped through two smaller 12-in. lines at a rate of 7000 bbl an hr. In a more recent operation, with two pumps handling heavy crude through two lines at a rate of 12,000 bbl an hr, and one pump handling light crude through one line, the station completed a loading of 287,000 bbl in an actual loading interval of 20 hr, or at an overall rate of 14,350 bbl an hr.

The entire project was completed under the supervision of Fritz Karge of Union Oil Company's manufacturing department, with the engineering and station construction work being done by J. B. Gill and Company. The outside pipe work was performed by Webb Construction Company. It took about six months to finish the job, largely because the loading and unloading had to be continued without interruption while work was in progress on the new installations. It should perhaps be explained here that Avila is also a bulk distributing station for the San Luis Obispo area. That is, refined products are delivered there by tanker from Wilmington and Oleum, and thence are distributed to retail outlets by truck. Gasoline constitutes a sizable part of these products. In any case, it was necessary in each instance to put in a new unit before taking out the old one, and there were times when, even in the pump station proper, old piping and new were being wrestled with at the same time. All this naturally presented quite a problem in engineering technique, which, however, appears to have been handled with due satisfaction to all concerned.

Yard work consisted of the construction of three new floating-roof tanks, two 113,000 bbl and one 135,000 bbl. Piping in the yard, of course, had to be changed also to facilitate the diverse operations, and some extra light storage was added to permit the handling of several commodities at the same time with a minimum of switching. The fire-fighting set-up also was completely converted from a wet to a dry system, permitting the conversion of foam fluid lines to water service. This required the installation of a centrifugal pump, powered by a gasoline engine, developing 270 bhp at 1750 rpm.

Terminal storage, amplified by the new tankage already described, now amounts to a million barrels; and the station tanks are all equipped with remote control gauging devices so that readings of fluid levels can be made without leaving the pumphouse. Pumps, incidentally, stop automatically when the pressure exceeds 125 psi, and can also be shut down by the operator on the wharf, by the mere pressing of a button, should it become necessary. Altogether, the Avila plant, by this overall process of revamping, has become a thoroughly modern institution, fully equipped for the part that it must play in the growth and development of the growingly important Pacific Coast states. * * *

Utah Indians Paid Royalties

A total of $195,000 was recently distributed to the 1568 members of the Unitah-Ouray Indian tribe for oil as dividends from oil discoveries on tribal lands. The sum amounted to more than $125 per person, in oil royalties and land rents for the Utah Indians.

One half of all funds received is transferred to a tribal reserve fund and the rest distributed at the discretion of the tribal business committee. The present payment is the largest yet made to the tribe following discovery of oil in the Unitah basin in 1948.

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PART 2—CONCLUSION

Engineering Data on Basin System

E. R. OSBURN*

Electrical

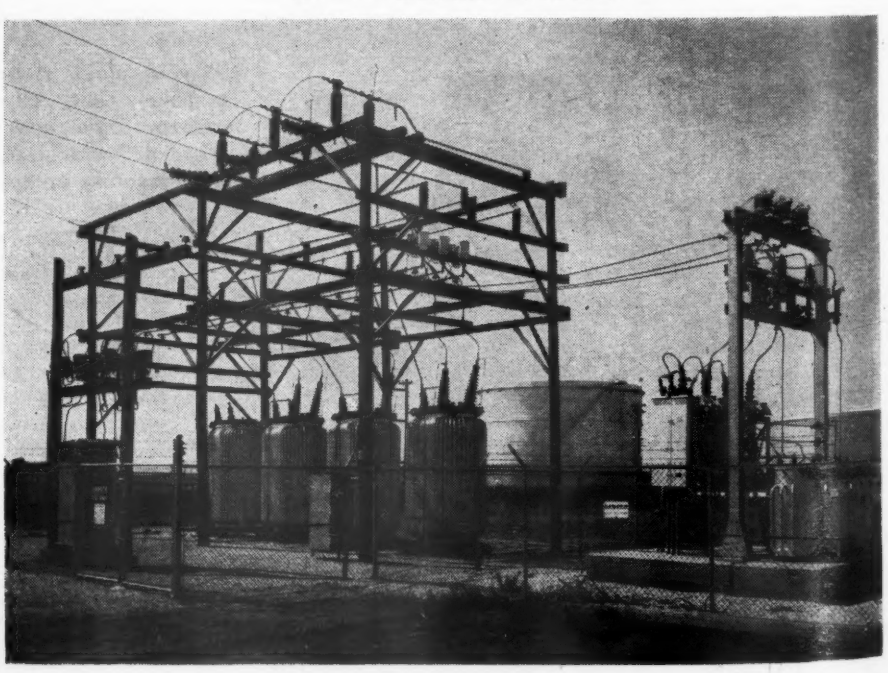
The electrical system at Jal station depends on the operation of gas engine driven generators of 187 kva 480-8330 3-phase, and an overhead distribution system serves the adjacent tank farm. The system provides power for 760-volt motors, which drive the booster pumps at each stock tank. Distribution transformers with 440-volt primaries, connected in Y and, 220-volt secondaries are used for tank farm lighting circuits and serve the motor operated valves. This voltage circuit, which is not generally used, was chosen for the reason that with 3-phase grounded circuits a higher potential than 440 volts is available for distribution purposes. Where 440-volt equipment such as transformers and motors may be Y-connected and operated direct, there are, therefore, some savings in transmission losses without added expense to provide equipment with higher voltage insulation. Secondary voltages of 120/208, 3-phase, connected in Y are provided within the station building for lighting, valve operators, and other equipment. This service is fed from the main switch gear bus through a circuit breaker direct to a bank of 480/240/120 voltage transformers with primaries and secondaries connected in Y. In general other stations contain like features to those at Jal, with the exception that stations at which crude oil storage tanks are located require remote control of booster pumps and valves.

Power for the all-electric stations is obtained from local utility companies. It is delivered to the station sites at 66 kv and then stepped down to 4160 volts at the power company's substation. (Fig. 12). Direct connections are made to the power company's overhead bus system to serve the pipe line company's adjacent auxiliary substation. The latter installation consists of an outdoor, oil-immersed, 100,000-kva interrupting capacity, main circuit breaker, and a bank of auxiliary transformers. At those stations where no tank farm is situated, these auxiliary transformers consist of three single-phase 37½-kva units with 2400-volt primaries Y-connected and 120-volt secondaries Y-connected to provide 120/208 volt, 4-wire auxiliary service. Where tank farm distribution systems are required, these transformers are 75-kva, 2400/240/-120-volt, oil-immersed units with a 1386-volt auto tap on each primary winding. The primaries are Y-connected and fed from the 4160-volt supply. With this arrangement, the tank farm distribution conductors are connected to the auto taps of the primary windings to produce 2400-volt, 3-phase service for the booster pumps. Tank farm lighting and valve motors are served from this 2400-volt system through appropriate distribution transformers. Secondary windings of the 75-kva transformers are Delta connected to provide 240/120-volt, 3-phase, 4-wire auxiliary service for the pump house and adjacent installations. As the transformers used are of a special type and are therefore not readily available for replacement in case of failure, a spare unit was obtained. The basic reason for specifying the type used was to eliminate the need for a second transformer bank to serve the tank farm distribution system.

An underground dual feed for the main power service is provided between the outdoor circuit breaker and the incoming line panel of the main switch gear. Each of the feeder circuits will carry the full load, so that a shut down of the station is prevented in case of cable failure in either one of the two circuits. The cables for the main power feed and service to other major equipment are varnish cambric, lead-covered copper placed in steel conduit, whereas the conductors used for lighting and small electrical equipment have type TW insulation. Insofar as practical, color coded wire was used, especially on control wiring, to facilitate installation and future maintenance work.

The main switch gear assemblies for each of the all-electric stations are identical, except for differences in rat-

FIG. 12. Substation structures.



*Assistant General Manager, The Texas Pipe Line Company.

FIG. 13. Top view of console desk.

ings of component parts occasioned by differences in horsepower ratings of main motors at the various locations. Each set of gear consists of an incoming line cubicle, control cubicles each for the three full capacity units and the half-unit, a low voltage cubicle and a sequence control cubicle. The equipment is metal clad and designed for full voltage starting of the 4160-volt, 1800-rpm, squirrel cage induction motors. Each motor control is equipped with a draw-out type air circuit breaker, having an interrupting capacity of 100,000 kva. These breakers are interchangeable. Protective devices are provided for under voltage, over current, unbalanced phase, and reverse phase. The customary voltmeters, ammeters, and integrating watthour meter are also included.

Within the low voltage and sequence control cubicles are situated the control equipment for the main motor blowers, the motor operators for suction and discharge valves, and necessary relays, timing devices, and other equipment required for the automatic sequence starting and stopping of the pumping units.

The actual physical control of these operations takes place at the console control desk situated in the bay window of the pump house control room. (Fig. 13). The desk top contains a flow diagram of the station pumping units. Indicator lights are provided to show the operating state of each unit, the oilflow, and the cause of certain faults that may develop within the pumping equipment. Start-stop push button stations for each main unit are on this desk also. To start a unit, the operator pushes the appropriate start button and the following operations automatically occur in the sequence given and with the proper time intervals:

1. Start motor ventilating blower.
2. Open suction valve.
3. Start main pump motor.
4. Open discharge valve.

Pushing the stop button brings about the following operations in a similar manner:

1. Stop main motor.
2. Close suction valve.
3. Close discharge valve.
4. Stop ventilating blower for main motor.

Safety and protective devices are provided to operate in conjunction with the main circuit breaker, main switch gear, and console desk equipment to perform the following functions:

1. Shut down individual unit in case of failure of respective ventilating fan supplying cooling for main unit motor.
2. Shut down unit in case either motor or pump bearings reach an unsafe temperature.
3. Shut down unit in case motor becomes overloaded.
4. Shut down unit in case the pump's case temperature becomes excessive.
5. Progressive shut down of units in the event that station case pressure exceeds a predetermined normal value. This action is controlled by a pressure device connected to the station discharge system immediately upstream from the station discharge pressure regulator valve. When this particular device functions, the pump in operation nearest the station discharge side shuts down and after a predetermined time delay the next pump shuts down and the action continues progressively until the pressure returns to normal, or until all units are shut down.
6. Shut down unit if its respective discharge valve fails to fully open when starting, or if started, either the discharge or suction valve of the unit leaves the fully open position.
7. Shut down all units by opening their individual circuit breakers in case the station suction pressure drops to a predetermined value.
8. Shut down all units as in paragraph 7 above in case station discharge pressure reaches a predetermined value. This action is controlled by a pressure device connected to the outgoing line of the station at a point downstream from the station discharge pressure regulator valve. This device is set to trip at a pressure somewhat lower than the station case pressure control.
9. Shut down station by tripping main outdoor circuit breaker in case of overcurrent.

An automatic reset-cutout type alarm system is provided to sound an alarm in case certain troubles develop. This device consists of a single howler or siren, which when it sounds may be locked out of the trouble circuit only by a single push button and automatically reset when the trouble is cleared. At the same time it is free to operate in case other trouble occurs. This alarm system operates for all nine protective features listed in the preceding paragraph and in addition sounds an alarm for the following occurrences:

1. Excessive temperature of main motors as indicated by search coils in motor windings.
2. Low air pressure supply that controls station discharge pressure regulator valve.
3. High sump level.
4. Failure of control room pressurizing blower.

The protective and alarm circuits are so arranged that the respective indicator lights will remain in service until the trouble is cleared, even after the alarm is silenced. All temperature control devices, except the search coils in motor windings, and all pressure control devices are of the Bourdon tube type, which actuate the necessary number of mercury type normally open and/or normally closed contacts required for the alarm and indicating equipment installed. Alarm and indication only for high sump level is used, and manual operation of the sump pump is provided in order to

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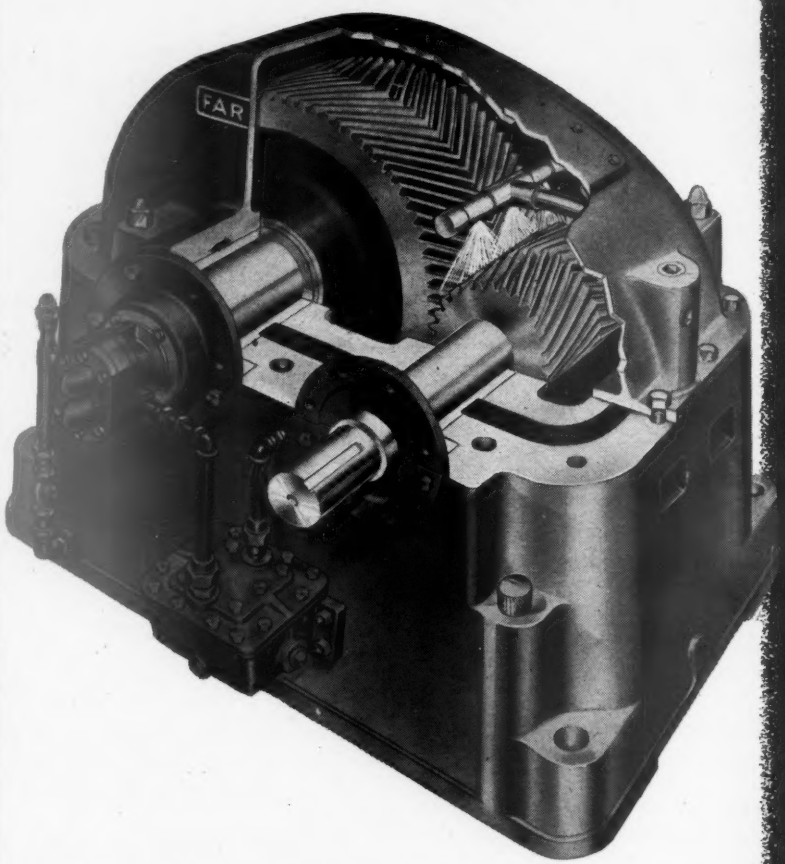

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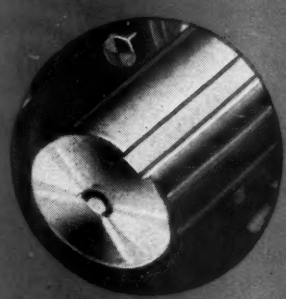

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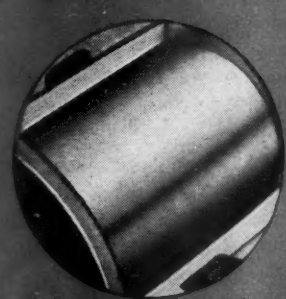

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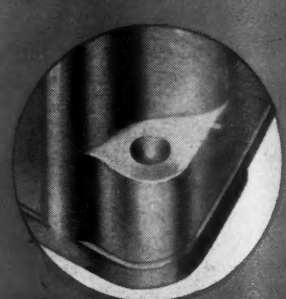


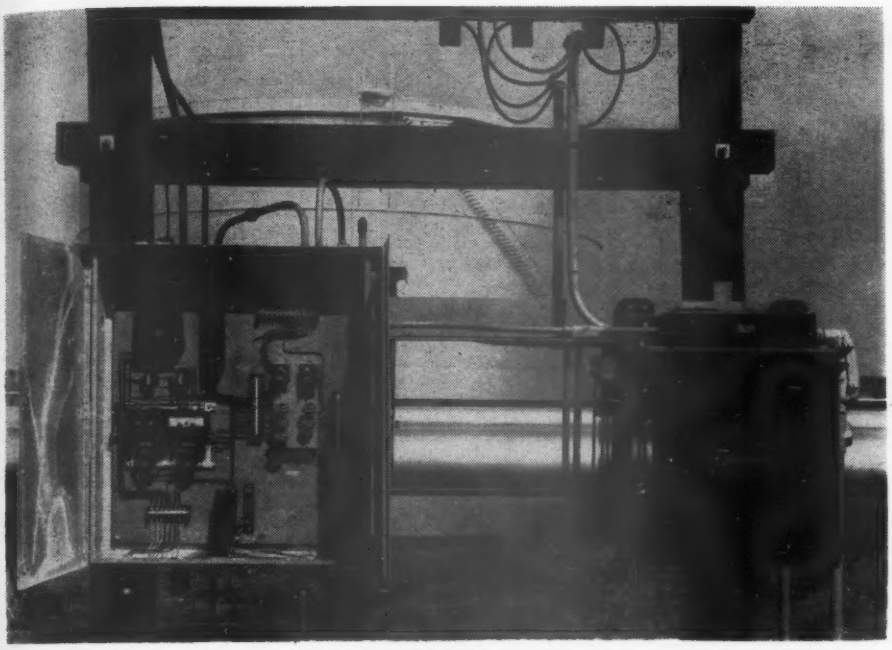


FIG. 14. Tank farm starter rack assembly.

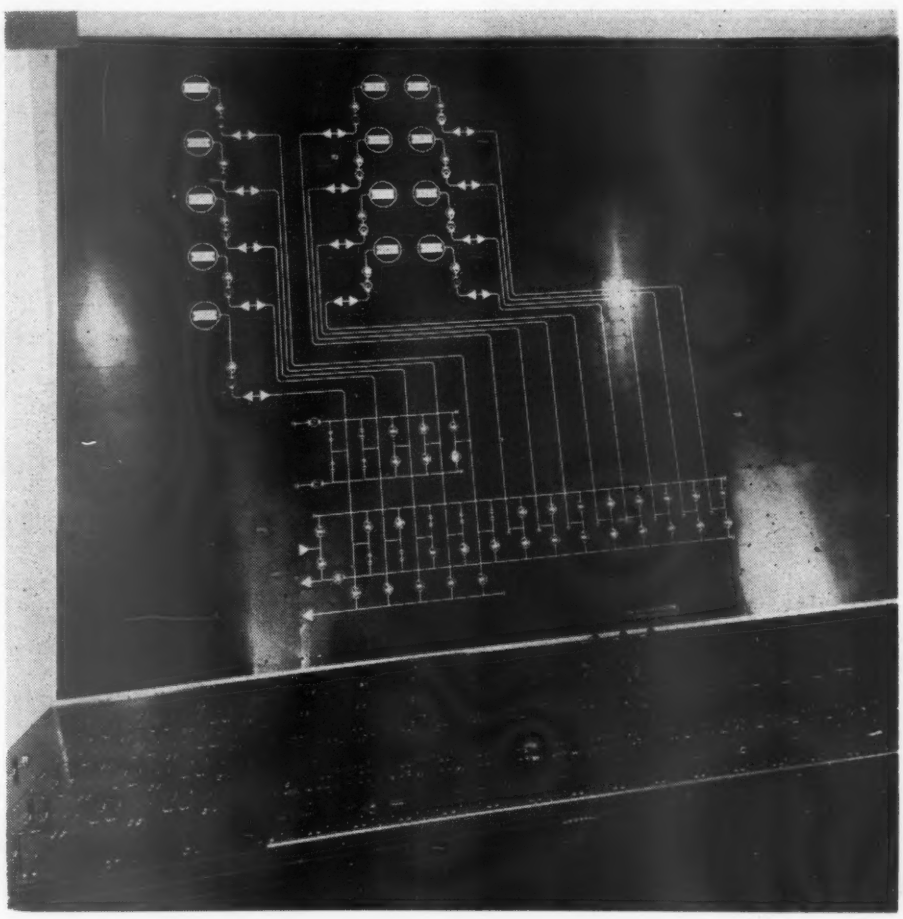
prevent the possible contamination of sweet crude batches with sour crude from the sump pit.

Secondary service is fed by underground cables from the auxiliary transformers in the substation to the unit control center situated in the switchgear room and the station lighting panel. The unit control center contains all control equipment for auxiliaries not otherwise provided for by the main switchgear. At the stations that have tank farms it contains the necessary circuit breakers and reversing starters for the manifold valve operators. Underground feeder and control wiring serve the manifold valve operators. Controls for tank farm valve and booster pump motors are installed on racks conveniently placed within the tank farms. (Fig. 14). Where motor operated valves were somewhat removed from the pump house, controls for these were placed nearby on racks. In some cases, equipment in explosion-proof housing was used, whereas in others oil immersed controls were provided. At the booster stations, remote control and indication for scraper trap valves, which have a bearing on station operation, were provided on the console desk. These valves have local controls also, as well as the motor operated valves of the scraper trap.

Remote control of manifold valves and tank farm valves and booster pumps was effected by providing a flow chart and control desk within the control room of the pump house. (Fig. 15). This piece of equipment consists of a vertical panel on which a diagram or map of the manifold, tanks, valves, pumps, and interconnecting piping is reproduced. Indicator lights are provided thereon to show operating status of the booster pumps and the position of each valve. Red lights are used to indicate a booster pump in operation and a valve in the open position. Green lights indicate a valve in the closed position. Both red and green lights burn when the respective valve is in an intermediate position. Lighted flow arrows indicate the direction of oil movement within the piping system involved. Control stations for the various units are conveniently placed and titled on the control desk attached to the lower portion of the flow chart. Each booster pump may be started or stopped by pressing a push button. A three position selector switch is provided for each valve, by which the desired operation of either closing, opening, or stopping the valve may be selected. This action merely arranges the control circuits for the desired operation and the actual functioning of the valve operator does not begin until an operating push button is pressed. When once set in motion, the valve motor remains in motion until the valve is fully opened or closed, at which time it is automatically stopped. The stop position on the selector switch allows for stopping the valve operator in an intermediate position if desired.

Valve motors situated within the

FIG. 15. Tank farm flow chart.



pump house or immediately adjacent thereto are controlled by alternating current at 208 or 220 volts, depending on the secondary voltage available at the station concerned. For remote control of tank farm equipment, direct current at 48 volts is utilized. This current is supplied by an industrial type, wetcell battery that is automatically maintained fully charged by a rectifier type battery charger. This control system involved the use of telephone type relays and control cables. Each d-c control circuit is wired through a test jack conveniently situated on the flow chart panel for use in locating trouble. The telephone cable used for tank farm controls consists of standard lead covered No. 22 multiple conductors with the number of standard pairs selected to suit requirements and to provide spare conductors. The poles of the tank farm distribution system are used to support the cable, which is suspended from messenger cable by spinning wire. At some locations a surplus Navy type communication cable, covered with basket weave, stainless steel armor was used instead of the lead covered type and its installation was similar to that used for the latter.

The electrical grounding system at each station consists of a 4/0 bare copper wire loop buried so that portions of the loop will lie beneath the building. All conduit and electrical equipment are then grounded to the loop by bare copper conductors of appropriate size. Standard practice provides for connection of the loop to copper clad steel ground rods. At several of the station sites, however, the usual ground rods, because of high resistant soil conditions, did not give adequate grounding, so 4-in. steel pipe well casings were sunk down to permanent moisture and connected to the loop. In order to further lower the contact resistance of the pipe, the backfill was treated with sodium hydroxide. Grounding of tank farm equipment in such locations was accomplished by extending a ground wire from the station grounding network out into the tank farm.

The large capacity of the pipe line system demands prompt and orderly manipulation of all equipment used to move and control the various batches of crude oil being transported. As the usual manual methods of operation and control are inadequate for such a system, the electrical design features have contributed materially toward providing an efficient and workable arrangement.

Communications

The operation of this pipe line system, extending from the oil fields of New Mexico to the delivery station at Cushing, Oklahoma, requires that reliable communications be established to all pump stations and working centers. A physical telephone circuit was built from Jal to Cushing, a three-channel carrier circuit was superimposed on the physical circuit between Midland and Wichita Falls, and a one-channel carrier circuit from Wichita Falls to Cushing. The physical circuit terminates at the Shell Pipe Line Corporation dispatcher's office at Cushing, Oklahoma. Connections are made from the communications system to The Texas Pipe Line Company's circuits at Wichita Falls and Texas-New Mexico Pipe Line Company's circuits at Midland, and The Texas-Empire Pipe Line Company's circuits at Cushing. The line operations are dispatched by The Texas Pipe Line Company from its Houston office. In the event of line difficulty the dispatchers at Houston may contact personnel of the Basin System through three separate circuits, one each to Midland. Wichita Falls, and Tulsa, thus permitting communication to this line from the center or from near its initial and terminal points. * * *

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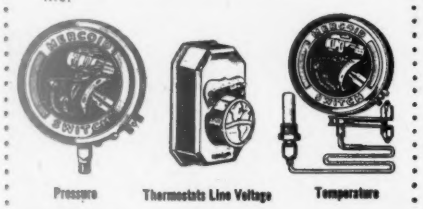

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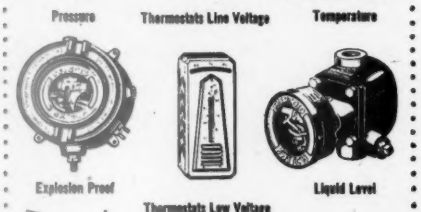

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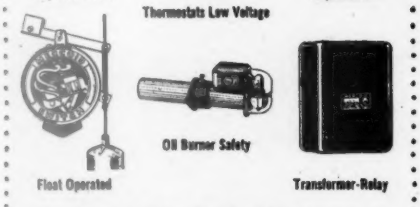

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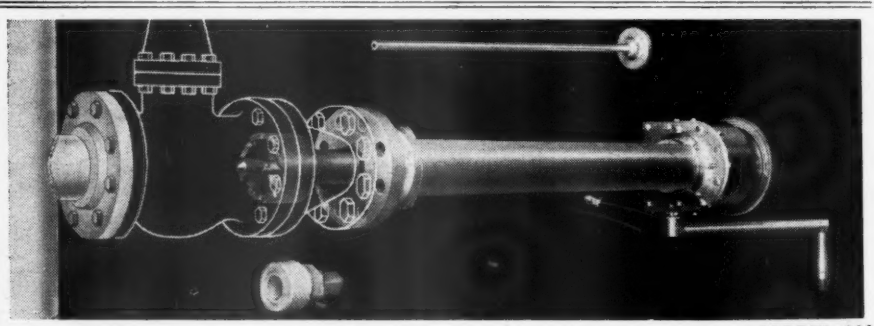

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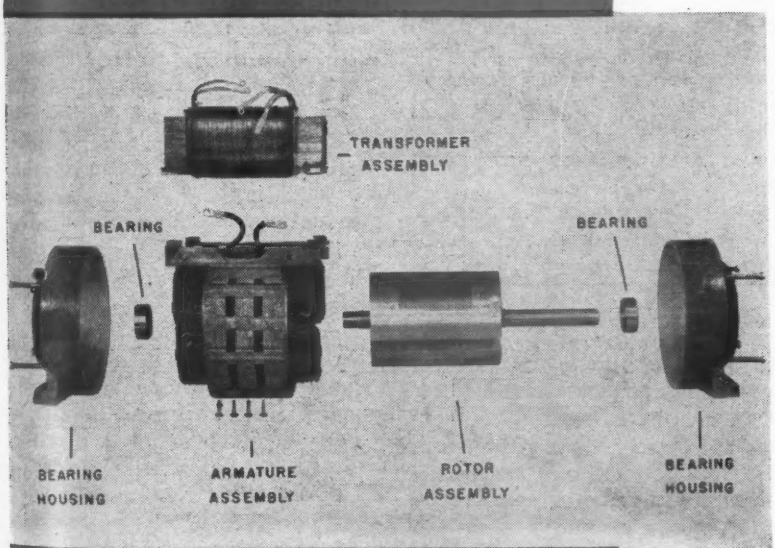

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P 615.635.4.

Cathodic Protection Notification Procedures

Nature of Problem and Purpose of Bulletin. Bulletin 1 prepared by the Correlating Committee on Cathodic Protection informs management about the economic value of cathodic protection as a technique for combating underground corrosion of buried metallic plant. This corrosion and its contingent losses are costing American industry about a billion dollars per year.

Bulletin 1 describes in layman's language how such corrosion—which is a chemical attack of Nature—can be stopped by cathodic protection, which consists in impressing suitable external electric currents into the structures via metal masses called "anodes" buried in the soil nearby.

Bulletin 1 also describes the stray current problem arising out of cathodic protection, and the need for a "good neighbor policy" in dealing with it. Concerning these the bulletin states:

"Some of the current introduced at the anodes to cathodically protect one structure may enter a neighboring structure and traverse it for a distance while enroute to the protected one. Where this current leaves the neighboring structure and enters the soil, corrosion occurs, which is similar to street-railway stray-current electrolysis. It can be prevented in several ways, one of the commonest of which is to connect the neighboring structure to the protected one by a wire 'drainage bond' of proper resistance.

"Because of this possibility of interaction, any operator planning a cathodic protection installation should notify operators of neighboring buried structures so that all concerned can appraise the interaction problems. Experience shows that these can be dealt with most effectively and satisfactorily through cooperative study and tests by the engineers of the operators involved."

This Bulletin, No. 2 of the series, further indicates the desirability for such cooperation, and suggests procedures by which it can be fostered.

Advantages of Cooperation. An operator intending to install cathodic protection on his structure, or to change existing installations, will be well advised to notify neighboring structure owners of his intention. This should be done while plans are being prepared. Such notification will initiate the cooperation needed not only to assure the operator of obtaining the protection sought for his own structure, but also to give his neighbors advance opportunity to consider possible stray-current corrosion or other undesirable effects on their structures. In addition, whenever a buried line or major extension is to be newly laid or removed, whether or not cathodic protection also is planned, the neighboring structure owners should be notified. This is because laying or removing the line may alter the electrical conditions on existing structures.

This is the second of a series of four bulletins on cathodic protection prepared, or being prepared, by the Correlating Committee on Cathodic Protection. Eleven nationwide organizations are sponsoring the work. Names of the organizations and committee members appear at the end of the article. The first bulletin in the series was published in *The Petroleum Engineer*, December, 1948, and the remaining two will appear in future issues.

If the notification covers a proposed cathodic protection installation, each neighbor in turn will be equally well-advised to respond to the notification and, if deemed necessary, to cooperate in an engineering survey aimed to appraise the extent, if any, to which the proposed installation may affect his own structure. Also, if the survey indicates that any undesirable effect is probable, the neighbor should cooperate in the engineering of preventive measures.

The advantages to be gained from taking the above-described steps before commencing installation are mutual. The installing operator will benefit because he may learn—during the planning stage—what preventive measures he must allow for, and thus he can predicate his design on all pertinent facts. Also there is afforded an opportunity to determine neighboring structure conditions before they may be altered by the new installation. The neighbors will benefit because prompt response and cooperation enables suitable preventive measures to be taken at the time of the installation.

Form of Notification. Because of the wide variation in types of installation, it seems impractical to present any standard form of notification. To minimize later inquiry, however, each notification should include the following pertinent data:

1. If a buried line is to be laid or removed:
   a. Size and type of construction.
   b. Location or route (inclusion of map or sketch is desirable.)
   c. Proposed dates of starting and completing construction or removal.
2. If a cathodic protection installation is proposed:
   a. Number and type of current supply units contemplated.
   b. Location of units (inclusion of map or diagram is desirable.)
   c. Proposed dates of starting and completing installations.
   d. Designation of operator's representative to whom response should be directed, or who should be contacted in regard to joint survey and other engineering aspects.

Who Should Be Notified. Presuming that the above-described cooperation is sought—and that it will result from proper notification and prompt response—every operator intending to install cathodic protection, or a new line, or both, or to remove a line, should determine what other structures may be exposed or affected thereby.

Depending on local conditions, the proximity of a cathodic protection system can affect buried pipe lines, metal-sheathed cables, rail track systems, and various other exposed metallic structures in contact with the soil. Transmission-tower footings and guy-wire anchors are involved occasionally. Cathodic installations also may affect the operation of railroad signal systems.

While such currents are most likely to affect merely the exposed structures that cross or are close to the protected one, they may in some cases affect others more remote. Depending on conditions, their sphere of influence may be narrow or broad.

Extent of Interaction Between Structures. A full discussion of the factors determining the extent of inter-

$1,000,000,000 down the drain

"CORROSION of buried plant and its contingent losses are costing American industry about a billion dollars per year," says the September, 1948, issue of the authoritative *Corrosion* magazine. If you operate water, gas or oil lines, communications, signal and power cables, rail tracks, tanks, equipment foundations, or a host of other metallic structures, buried or in unprotected contact with soil or water, you are no doubt footing your share of this colossal waste.

What to do?

The answer is to install proper cathodic protection against the spontaneous electric currents which flow from these metallic structures into the soil or water. These currents, weak though they be, cause disastrous corrosion of the metal at their point of exit. For example, a current outflow of one ampere in one year accompanies a loss of as much as 20 pounds of iron or steel, or 70 pounds of lead.

Ground anodes and backfill material made by National Carbon Company, Inc., effectively eliminate losses due to such currents by the simple method of reversing the current flow. A power source is connected to the buried structure and also to the anode bed which protects it. Current moves through the soil *from the bed* to *the structure*, and thence back to the power source, thus preventing any outflow of current from the structure into the ground. "National" Ground Anodes are low in cost, give long service, reduce maintenance costs to the minimum and have been tried and proved for 14 years.

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Write to National Carbon Division of Union Carbide and Carbon Corp., for Bulletin M-8500A giving complete information of "National" carbon, graphite, and special Na graphite ground anodes; also BF-2 backfill material. Tells which type to use for varying conditions. Gives sizes, spacing, weights, all technical details needed in ordering or installing.

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action between a cathodically protected structure and an exposed one is too technical for this bulletin. However, three factors especially deserve mention herein and careful consideration by all concerned, to wit:

a. *"Influence" of Protective Installation:* The tendency of the protective currents to stray to and influence neighboring exposed structures can be minimized (1) by judiciously locating the anodes; (2) by using additional and well-separated anodes if necessary to reasonably distribute the protective current and thus limit the amount introduced into the earth at any single location; and (3) by insulating or coating the protected structure so that the required protective currents—and hence the possible stray currents—are kept to a minimum.

b. *"Coupling" Between Structures:* Coupling depends on (1) earth resistivity and (2) structure separation. The higher the earth resistivity (resistance per unit cube), the greater is the area over which the protective currents will migrate. The greater the separation between the protected and exposed structures in the earth, the less is the interaction between them.

c. *"Susceptiveness" of Exposed Structure:* Exposed structures that are insulated by coatings, and those of poor electrical conductivity, are less likely to be affected by stray currents than are bare structures and those of high conductivity. Well-insulated structures present a minimum exposure to stray currents. However, coating insulation can deteriorate in service, in which event its protective value is correspondingly reduced.

From the foregoing it appears that the factor of "influence" is substantially under the control of the designer of the protective system. Thus, in designing the system, he should use the best techniques consistent with overall economy. "Coupling" depends also on soil resistivity that cannot be controlled, but it can be minimized to the extent that, by advance planning, operators may be able to avoid the close association of their structures.

"Susceptiveness" is under the control of every operator on his own new structures, whether or not cathodic protection is used. Cathodic protection is becoming widely recognized and applied as a practicable means of reducing corrosion of buried structures. Thus overall benefits will accrue if every operator will design and install his new plant so as to keep its susceptiveness as low as possible. This may involve, e.g., use of coatings or of insulated joints. By minimizing exposure of the new line to stray-current corrosion, the operator also will minimize its exposure to natural corrosion.

Sources of Data on Structure Locations and Owners. The act of proper notification obviously requires the installing operator to know also which neighbors own the other structures that may be involved. The notices preferably should be directed to operating officials presumed to have jurisdiction in such matters. In urban areas where structures are relatively short and the neighbors are usually well-known, this information should be readily obtainable. Where urban "joint electrolysis committees" exist,* such information usually can be obtained from their chairmen or secretaries. But an operator who intends to install or protect a long line traversing many miles of varied country may have greater difficulty in determining whom to notify.

To assist in this matter, certain generally available sources of data on structure locations, ownerships, operating personnel, et cetera, are called to attention herein.†

Railroads: Several types of maps are available to show the routes of railroads. A four-sheet general map to scale 1/2,500,000 is the "Railroad Map of the United States."[1] Handy identity and distance maps in atlas form are available in two forms.[2,3] The best exact route alignment data generally available at nominal cost are in the maps of the U. S. Geological Survey. These include a series of state maps to scale (most of them) of 1/1,000,000[4a]; another state map series to scale (most of them) of 1/250,000[4b]; and the many regular topographic quadrangles varying in scale from 1/62,500 to 1/24,000[4c]. List of rail carriers, with business addresses and names of key personnel appear in The Pocket List of Railway Officials.[5]

Electric Railways: A list of headquarter cities of electrified rail carriers, with names of carriers, and their business addresses, key personnel and system data, appears in Mass Transportation Directory.[5] Most of the carriers issue handy maps of their systems.

Petroleum Pipe Lines: Industry fostered maps to scale 1 in. = 24 mi showing all crude oil and products trunk pipe lines in (a) Central United States or (b) Eastern United States can be purchased at nominal cost.[6] These maps indicate the names of the line operators. Maps of such lines in California can be obtained as of May, 1949, only from private sources. Lists of most oil pipe line carriers, with business addresses and names of key personnel, appear (among other places) in the Petroleum Register[7] and the Directory of Pipe Line Personnel.[8]

For the oil-producing country, where innumerable oil gathering and field service pipe lines exist, composite line maps are not usually available. However, local field maps showing the individual oil properties or "leases," and names of their operators or "producers," usually can be purchased from various sources. Field line maps of oil and gas producers, and gathering maps of the various pipe line carriers, usually can be inspected at the producers' and carriers' district, division, and head offices.

Gas Pipe Lines: A general map can be purchased titled "Principal Natural Gas Pipe Lines of the United States".[9] Data on location of local gas distribution lines may be obtained at the utilities' local business offices. A list of gas companies, with business addresses, names of key personnel and considerable system data appears in Brown's Directory of American Gas Companies.[10]

Water Pipe Lines: Most water pipe lines are confined to urban areas, although there are also suburban companies, and some of the larger urban systems are served by feeder lines from outlying reservoirs, et cetera. Data on locations of water lines may be obtained at the operators' local business offices, or, if municipally-owned systems, from the city engineers' or public works administrators' offices. Lists of the city engineers, water works superintendents (where systems are municipally owned), street superintendents, and superintendents of sewerage for the 1072 cities having more than 10,000 population are listed in The Municipal Index and Atlas.[11] Another source of water system personnel information is the membership list of American Water Works Association.

Central Steam Heating and Refrigeration Pipe Lines: Pipe lines of companies supplying these services are confined to a relatively few urban areas. Data on locations of these lines may be obtained at the operators' local business offices.

Electric Power Cables and Transmission Lines: Data on locations of electric power cables, which generally are confined to urban areas, may be obtained at the utilities' local offices. General maps of principal suburban, interurban, and interstate transmission lines appear in atlas of Principal Electric Facilities of the United

*An available list of "joint electrolysis committees" is given in Appendix A.

†Publishers of the source material are listed in Appendix B.

[1-10]Refers to list in Appendix B.

States.[13] Lists of cities and towns, with names of the electric utilities in each, and their business addresses and officials, appear in the Central Station Directory.[14]

Communications Cable—Bell System: These cables may extend interstate and interurban as well as in urban areas. They are classified as "underground" if in ducts, and as "buried" if plowed or trenched in. Data on their locations may be obtained from the district or division plant superintendents of the Bell System operating in the area involved. Lists of the cities and towns served by each of these companies, their operating areas, and the business addresses and key personnel of their head offices (and in some cases their area offices), appear in Telephony's Directory.[15] It is proper to notify the above referred to superintendents concerning involvement of local and intra-state cables. In cases involving interstate cables, the district plant superintendents of the long lines department of the American Telephone and Telegraph Company should be notified. Their headquarters offices are listed in Appendix C.

Communications Cables—Independent Telephone Companies: These cables, underground or buried, may extend interurban as well as in urban areas. Data on their locations may be obtained from the offices of the companies. Lists of the cities and towns served by independent companies, with company names, business addresses and key personnel, appear in Telephony's Directory.[15]

Communications Cables—Western Union: Underground and buried cables of Western Union Telegraph Company are confined principally to urban areas. Data on their location may be obtained from the company's local plant and engineering department. Notification should be addressed to area superintendent, plant and engineering. Their headquarters offices are listed in Appendix D.

Municipal Signal Systems: Underground and buried municipal signal cables are confined to urban areas. Data concerning their location may be obtained from local offices of fire and police authorities. Lists of the fire chiefs and police chiefs of cities with more than 10,000 population appear in the Municipal Index and Atlas[12] and in The Municipal Year Book.[16] A source of the names of the signal system superintendents is the membership list of International Municipal Signal Association.

Joint Industry Committees. Reference has been made to the existence in many urban areas of "joint electrolysis committees" through which the problems of notification and joint survey in corrosion mitigation are being handled with a minimum of effort and a maximum of cooperation. These committees usually are composed of representatives from each operator of buried structures in the area. The success that has attended their efforts indicates their value.

It would seem that the voluntary formation of somewhat similar committees can assist in the correlation of cathodic protection notification and survey problems in other urban areas and in non-urban areas, these latter appropriately sized according to community of interests. In some non-urban areas there may be so many operators that it will be impractical for all of them to have individual representation on the committees. In such areas the committee perhaps can more practically be composed of one or two representatives informally selected by the interested operators in each concerned industry, thus giving the committees a composition similar to that of the Correlating Committee on Cathodic Protection.

APPENDIX A

Joint Electrolysis Committees

Electrolysis Survey Committee of Baltimore City: Chairman, Hugh H. Hunter, Public Service Commission, Baltimore 2, Maryland.

Chicago Joint Electrolysis Committee of Various Utility Companies: Chairman, L. F. Greve, Commonwealth Edison Company, Chicago 90, Illinois.

Cincinnati Committee on Electrolysis: % Edgar Dow Gilman, City Hall, Cincinnati, Ohio, (temporarily inactive).

Cleveland Committee on Electrolysis: Chairman, G. R. Canning, Ohio Bell Telephone Company, 750 Huron Road, Cleveland 15, Ohio.

Denver Committee on Electrolysis: Chairman, A. M. Spaulding, Mountain States Telephone and Telegraph Company, Denver, Colorado.

Des Moines Electrolysis Committee: Chairman, Earl Olmsted, Des Moines Gas Company, Des Moines, Iowa.

Detroit Committee on Electrolysis: Chairman, R. M. Lawall, American Telephone and Telegraph Company, 1814 Book Tower, Detroit 26, Michigan.

Joint Committee for the Protection of Underground Structures in the Eastbay Cities: Chairman, M. N. Clark, Pacific Gas and Electric Company, 1625 Clay Street, Oakland 12, California.

Louisville Electrolysis Committee: Chairman, S. H. Gates, Southern Bell Telephone and Telegraph Company, P. O. Box 538, Louisville, Kentucky.

Milwaukee Electrolysis Committee: Chairman, Glenn Chamberlain, Milwaukee Gas Light Company, Milwaukee, Wisconsin.

New Haven Electrolysis Committee: Chairman, F. P. Nettleton, Southern New England Telephone Company, 227 Church Street, New Haven 6, Connecticut.

Greater New York Electrolysis Committee: Chairman, Sumner Hayward, New York Telephone Company, 101 Willoughby Street, Brooklyn 1, New York.

Omaha-Council Bluffs Electrolysis Committee: Chairman; J. C. Detweiler, Metropolitan Utilities District, Utilities Building, Omaha, Nebraska.

Suburban Philadelphia Electrolysis Committee: Chairman, A. V. Smith, 370 Trevor Lane, Bala-Cynwyd, Pennsylvania.

Pittsburgh Corrosion Committee: Chairman, C. A. Erickson, Peoples Natural Gas Company, 545 William Penn Way, Pittsburgh, Pennsylvania.

Roanoke Electrolysis Committee: % C. M. Baldock, Chesapeake and Potomac Telephone Company, Roanoke, Virginia.

Sacramento Underground Joint Committee: Chairman, C. M. Hoskinson, 112 City Hall, Sacramento, California.

San Francisco Area Joint Committee: Acting Chairman, L. M. Perrin, Hetch Hetchy Water Supply, San Francisco, California, (now being organized).

Electrolysis Committee of Southern California: Chairman, I. C. Dietze, Department of Water and Power, Box 3669, Terminal Annex, Los Angeles 54, California.

Wheeling Coordinating Committee on Corrosion: % C. F. Aulick, Jr., C. & P. Telephone Company of West Virginia, Wheeling, West Virginia, (temporarily inactive).

Youngstown Committee on Electrolysis: Chairman, F. W. Nimer, Ohio Edison Company, Akron, Ohio.

APPENDIX B

Publishers of Maps and Directories

1. Railroad Map of the United States (annual). Commanding Officer, Army Map Service, 6500 Brooks Lane, Washington 16, D. C.
2. Handy Railroad Atlas of the United States (annual). Rand McNally and Company, 536 South Clark Street, Chicago, Illinois.
3. Leahy's Hotel Guide and Travel Atlas (annual). American Hotel Register Company, 226 West Ontario Street, Chicago 10, Illinois.
4. (a) State Index Maps—without red overprints, scale 1/1,000,000 (5¢ each).
   (b) State Maps to 4 x scale of Index Maps, scale 1/250,000 (25¢ each).
   (c) U. S. Topographic Quadrangles, various scales (10¢ each).
   The Director, U. S. Geological Survey, Washington 25, D. C.
5. The Pocket List of Railway Officials (quarterly). Railway Equipment and Publishing Company, 424 West 55th Street, New York, New York.
6. Mass Transportation Directory (annual). Kenfield-Davis Publishing Company, 608 South Dearborn Street, Chicago 5, Illinois.
7. Maps of "Petroleum Pipe Lines in" (a) "Central United States" or (b) "Eastern United States" (kept up-to-date). L. L. Ridgway Company, 615 Caroline Street, Houston, Texas.
8. Petroleum Register (annual). Mona Palmer, 794 Stanford Avenue, Los Angeles 21, California.
9. Directory of Pipe Line Personnel. Midwest Oil Register, P. O. Box 892, Tulsa, Oklahoma.
10. Map of "Principal Natural Gas Pipe Lines of the United States." Federal Power Commission, Washington, D. C.
11. Brown's Directory of American Gas Companies (annual). Moore Publishing Company, 9 East 38th Street, New York, New York.
12. The Municipal Index and Atlas (annual). American City Magazine Corporation, 470 Fourth Avenue, New York 16, New York.

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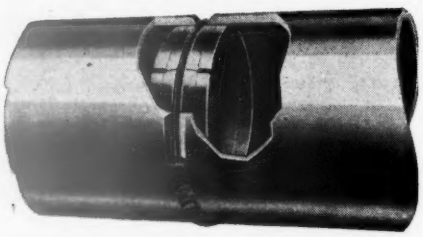
WEDGE Chill Rings with the patented features offer you two distinct advantages—they will assure STRONGER joints and SAVE MONEY. They reinforce the joints, making them the STRONGEST part of the line—in case of shock, strain or vibration the pipe will fail before the reinforced joints.



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13. (a) Maps of "Principal Electric Facilities in the United States" (complete coverage in atlas form).
    (b) Maps of "Principal Electric Utility Generating Stations and Transmission Lines" (separate maps for 11 regions and 6 congested areas).
    Federal Power Commission, Washington, D. C.
14. Central Station Directory (annual). McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York, New York.
15. Telephony's Directory (annual). Telephony Publishing Corporation, 608 South Dearborn Street, Chicago, Illinois.
16. The Municipal Year Book (annual). The International City Managers' Association, 1313 East 60th Street, Chicago, Illinois.

APPENDIX C

Location of District Offices of The American Telephone and Telegraph Company

Long Lines Department

Birmingham 3, Alabama, Room 703, Comer Building.
Denver 2, Colorado, 931 14th Street, Room 404.
West Haven 16, Connecticut, P. O. Box 31.
Jacksonville 2, Florida, Room 1130, Lynch Building.
Atlanta 3, Georgia, Room 909, 51 Ivy Street.
Joliet, Illinois, 7 East Clinton Street.
Springfield, Illinois, 422 South 5th Street.
Indianapolis 4, Indiana, Room 602, 240 North Meridian Street.
Boston 9, Massachusetts, Room 505, 125 Milk Street.
Detroit 26, Michigan, 1814 Book Tower.
Minneapolis 2, Minnesota, 420 3rd Avenue.
Kansas City 6, Missouri, 1426 Locust Street.
St. Louis 3, Missouri, 2651 Olive Street.
Omaha 2, Nebraska, 723 Service Life Building, 1904 Farnum Street.
Newark 2, New Jersey, Room 1106, National Newark Building, 744 Broad Street.
Albuquerque, New Mexico, 300 West Copper Avenue.
Albany 1, New York, Room 803B, 158 State Street.
Buffalo 2, New York, 51 Erie Street.
Charlotte, North Carolina, Room 308, 208 North Caldwell Street.
Cincinnati 2, Ohio, Room 810, 209 West 7th Street.
Cleveland 15, Ohio, Room 531, 750 Huron Road.
Harrisburg, Pennsylvania, 124 Pine Street.
Philadelphia 6, Pennsylvania, 648 Bourse Building.
Pittsburgh 19, Pennsylvania, 416 7th Avenue.
Nashville 3, Tennessee, 1113 Nashville Trust Building.
Dallas 4, Texas, 4100 Bryan Street.
Richmond 19, Virginia, Room 1120, Central National Bank Building.
Washington, D. C., 1809 G Street, N. W.

APPENDIX D

Locations of Area Offices of The Western Union Telegraph Company

(Notify: Area Superintendent—Plant and Engineering)

Los Angeles 14, California, 745 South Flower Street.
Oakland 12, California, 125 Twelfth Street.
Atlanta 3, Georgia, 56 Marietta Street.
Chicago 5, Illinois, 427 South La Salle Street.
New Orleans 12, Louisiana, Carondolet and Perdido Streets.
Boston 10, Massachusetts, 230 Congress Street.
Detroit 26, Michigan, 526 Shelby Street.
Minneapolis 1, Minnesota, 317 Second Avenue, South.
Kansas City 6, Missouri, 114 East Seventh Street.
St. Louis 1, Missouri, 910 Chestnut Street.
New York 13, New York, 60 Hudson Street.
Syracuse 2, New York, 351 South Warren Street.
Cincinnati 2, Ohio, 216 Dixie South Terminal Building.
Portland 5, Oregon, 239 South West Broadway.
Philadelphia 7, Pennsylvania, 230 South Eleventh Street.
Dallas 1, Texas, 2028 Main Street.

Correlating Committee on Cathodic Protection

Chairman: H. H. Anderson, American Petroleum Institute.

Secretary: F. E. Dolson, Jr., American Water Works Association.

AMERICAN GAS ASSOCIATION: Guy Corfield, Southern California Gas Company, Los Angeles, California; F. J. McElhatton, Panhandle Eastern Pipe Line Company, Kansas City, Missouri.

AMERICAN PETROLEUM INSTITUTE: H. H. Anderson, Shell Pipe Line Corporation, Houston, Texas; L. F. Scherer, The Texas Pipe Line Company, Houston, Texas.

AMERICAN PUBLIC WORKS ASSOCIATION: Robert J. Kuhn, consulting engineer, New Orleans, Louisiana; W. R. LaDue, Bureau of Water and Sewerage, Akron, Ohio.

AMERICAN WATER WORKS ASSOCIATION: F. E. Dolson, Jr., St. Louis County Water Company, St. Louis, Missouri; A. R. Davis, City Water Department, Austin, Texas.

ASSOCIATION OF AMERICAN RAILROADS: R. B. Amsden, Illinois Central Railroad, Chicago Illinois; A. E. Archambault, New York Central Railroad, New York, New York.

BELL SYSTEM: K. L. Maurer (deceased), Bell Telephone Laboratories, New York; J. M. Standring, American Telephone and Telegraph Company, New York.

EDISON ELECTRIC INSTITUTE: J. J. Pokorny, Cleveland Electric Illuminating Company, Cleveland, Ohio; M. W. Ghen, Duquesne Light Company, Pittsburgh, Pennsylvania; (Alternate: C. K. Poarch, Edison Electric Institute, New York).

INTERNATIONAL MUNICIPAL SIGNAL ASSOCIATION, INC.: John D. Southwell, superintendent of fire and police communications, Beaumont, Texas; Frank Smith, superintendent of fire alarm, Tulsa, Oklahoma.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS: M. C. Miller, Ebasco Services, Inc. New York, New York; O. C. Mudd, Shell Pipe Line Corporation, Houston, Texas.

UNITED STATES INDEPENDENT TELEPHONE ASSOCIATION: G. W. Miller, Rochester Telephone Corporation, Rochester, New York; G. C. Richert, U. S. Independent Telephone Association, Washington, D. C.

WESTERN UNION TELEGRAPH COMPANY: L. S. Terrell, Western Union Telegraph Company, Atlanta Georgia; E. A. Cooke, Western Union Telegraph Company, New York. ★ ★ ★

At the edge of the Hudson River opposite 132nd Street, New York, a section of the Transcontinental gas pipe line is ready to be laid. In the background is the big gas holder of Consolidated Edison, which by the Fall of 1950 will be receiving natural gas from the line.

Transcontinental Gas Line To Be Finished This Year

THIS year will see the completion of the 1840-mile Transcontinental gas pipe line from the Rio Grande Valley to New York City and the first large-scale delivery of natural gas to Manhattan, Brooklyn, and Long Island, according to Claude A. Williams, president of Transcontinental Gas Pipe Line Corporation. The initial delivery of gas through the new line into New York City is now scheduled for about November 1, Williams announces.

Distribution of the gas delivered by Transcontinental will be through existing privately owned utilities in the Philadelphia-New Jersey-Metropolitan New York region. These include Consolidated Edison Company of New York, Brooklyn Union Gas Company, Kings County Lighting Company, Brooklyn Borough Gas Company, Long Island Lighting Company, Public Service Electric and Gas Company, Elizabethtown Consolidated Gas Company, South Jersey Gas Company, and Philadelphia Electric Company.

The first segment of the line extending more than 600 miles from Eunice, Louisiana, to Athens, Georgia, which was begun in May, 1949, is about completed, Williams reports. Contracts have been let on nine construction spreads totaling 707 miles which will take the line from Athens, Georgia, to the Hudson River crossing at 132nd Street, New York City. Construction at the New Jersey end of the line was begun in December and the contractors plan to work throughout the winter. The southernmost portion of the line, covering 514 miles from Eunice, Louisiana to Mercedes, Texas, the Rio Grande Valley terminus, will be started in February.

Separate contracts have been let to carry the pipe line under such major rivers as the Hudson and Mississippi and to bridge other rivers including the Coosa River in Alabama.

Transcontinental now has pending before the Federal Power Commission an application seeking an increase in the line's authorized capacity from 340,000,000 to 505,000,000 cu ft daily. Granting of the increased authorization would change several miles of pipe at the northern end and 200 miles of line at the southern end from 26 to 30-in. diameter. The number and arrangement of compressor stations will be changed to bring the total to 20 with a combined capacity of 220,000 hp.

The following contracts have been let for the final stages of the main line:

Spread No. 7—Williams Brothers Corporation, 86 miles, from Danielsville, Georgia to Saluda River, South Carolina.

Spread No. 8—R. H. Fulton and Company, 102 miles, from Saluda River to Catawba River, North Carolina.

Spread No. 9—R. H. Fulton and Company, 100 miles, from Catawba River to N. Carolina-Virginia boundary.

Spread No. 10—Smith Contracting Corporation, 86 miles, from North

Continued on Page D-28

NEWS

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Carolina-Virginia boundary to James River, Virginia.

Spread No. 11—Smith Contracting Corporation, 110 miles, from James River to Potomac River, Virginia.

Spread No. 12—Associated Pipeline Contractors, 74 miles, from Potomac River to Susquehanna River, Pennsylvania.

Spread No. 13—Wunderlich and Griffis Construction Company, 84 miles, from Susquehanna River to Delaware River.

Spread No. 14—Wunderlich and Griffis Construction Company, 41 miles from Delaware River to Hackensack River, New Jersey.

Spread No. 15—Oklahoma Contracting Corporation, 24 miles, from Hackensack River to Hudson River, New York.

Welding Patent Data Made More Available

The department of welding engineering at Ohio State University has announced completion of a new Patent Classification Index in the A. F. Davis Welding Library, designed to make information on more than 12,000 U. S. patents on welding more easily available to industry and educational institutions.

Each patent in the library is classified or indexed in several different ways—by process, material, product, use, inventor's name, date of issue, etc., on a single keysort card. These cards are sorted mechanically, and in very little time the numbers of patents pertaining to a given field may be determined.

The index covers not only the fundamental patents on welding processes and equipment but also the very important field of industrial applications of the welding processes.

Essentially, the type of information made available through the system is in the form of patent numbers relating to a designated area. Interested industrial organizations then may order those patent specifications from the patent office and refer to the material covered. The patent specifications are on file in the Davis Library and may be consulted by anyone.

The use of the patent classification system is offered to industrial organizations, individuals, and educational institutions. Services are free of charge to those who make use of the index system in person, but modest charges to defray clerical expense will be made for inquiries handled by mail, Professor Green announced.

E. P. Doremus | W. E. Huddleston | Gaines Laster

Corrosion Short Course To Be Held in Tulsa

Widespread demand for practical training in corrosion control for pipe line superintendents, foremen, engineers, and inspectors has resulted in plans, announced by the Tulsa Section of NACE, for a 4-day school to be held February 20 through 23 at Tulsa, Oklahoma.

According to R. L. Bullock, Interstate Oil Pipe Line Company, the short course will cover pipe coatings, anode and rectifier installations, and pipe corrosion testing.

Two full days will be devoted to field work at pipe line locations, emphasizing the practical economies to be derived from proper application of proved corrosion control methods.

Assisting Bullock in planning and direction of the school will be F. E. Pyeatt, Mid-Continent Pipe Line Company, J. C. Stirling, Stanolind Pipe Line Company, I. B. Tietze, Phillips Pipe Line Company, and other leading corrosion men in the Tulsa area.

Three recognized authorities have been obtained to conduct the training course: E. P. Doremus, W. E. Huddleston, and Gaines Laster.

W. E. Huddleston, whose 20 years of pipelining includes some 15 years in the study and mitigation of corrosion, is now head of the Huddleston Engineering Company of Bartlesville, Oklahoma.

Gaines Laster, a partner in the Tulsa Pipe Coating Company, has devoted some 16 years to coating operations on major pipe line projects in this country and abroad.

E. P. Doremus of Cathodic Protection Service, Houston, Texas, has served the oil industry since 1936 in research engineering as well as the design and installation of cathodic protective systems.

Registration fee of $5.00, including bus transportation to field locations, should be sent to Frank E. McNulty, Thompson Building, Tulsa.

Operating Revenues of Gas Companies Announced

Operating revenues of natural gas companies filing reports with the Federal Power Commission totaled $964,551,000 in 1948, the commission states in the 1948 edition of its annual publication "Statistics of Natural Gas Companies". Sales of natural gas by the companies during the year amounted to 3.99 trillion cu ft.

The publication, compiled from reports filed with the commission by 121 natural gas companies, contains both financial and operating data.

To Build Tanker in Two Parts for First Time

A report from the Sunderland shipbuilders, J. L. Thompson and Sons, Ltd., of Great Britain, indicates that, with the scheduling of the laying of the keel of the after-end of a 23,000 dwt tanker for Olsen and Ugelstad of Oslo, in April, 1950, the vessel will be the first tanker to be constructed in two parts. In order to accommodate the two large sections both berths in the yard are to be joined. The North Eastern Marine Engineering Company, Ltd., will fit a Doxford-type engine in the after-end of the tanker while John Crown and Sons, Ltd., a subsidiary of J. L. Thompson and Sons, proceed on the construction of the fore-part.

Shell Sells Some of Its Gathering Systems

Shell Pipe Line Corporation announces the sale effective January 3, 1950, to Wilcox Oil Company of its gathering systems serving the Dill, East Cromwell, Stroud, and East Stroud areas; also, the trunk lines extending from these areas to Shell's Cushing, Oklahoma, tank farm. The sold facilities will be operated by the new owner to continue gathering service to the now-connected producers.

NEW...

and 11 ways better!

Worthington Achieves a Triumph in Modern Angle Gas Engine Compressor Design with the Uniflo TYPE UTC-16's...Thru-Scavenging, 2-Cycle Engines of 800—2,000 HP that Hit New Highs in Efficiency AND Economy...Outstanding on Pipeline Duty

1. UNIFLO SCAVENGING — A RADICAL IMPROVEMENT OVER CONVENTIONAL LOOP SCAVENGING.

AIR PORTS AROUND ENTIRE CIRCUMFERENCE OF CYLINDER. Port area more than double.

EXHAUST THRU CAM OPERATED TIMED VALVES IN CYLINDER HEAD. Area 50% greater.

STRAIGHT LINE AIR FLOW thoroughly cleanses and cools entire cylinder.

SUPERCHARGING. Timed valves retain greater weight of pure air for perfect combustion.

THESE IMPROVEMENTS result in higher mean effective pressures without increased temperatures.

2. EN BLOC FRAME — permits use of removable cylinder liners.

3. DOUBLE AIR MANIFOLDS — doubles volume of air and steadiness of flow.

4. RENEWABLE CYLINDER LINERS — mean longer life and low-cost maintenance.

5. PISTON — completely symmetrical outer piston wall — wrist-pin supported in separate carrier.

6. CYLINDER HEAD — Worthington cone-type ... two large exhaust valves — streamlined passages.

7. GEAR DRIVEN CAMSHAFT — assures positive drive and perfect timing.

8. IMPROVED COOLING — jacket water space cast integral with liners, eliminating internal water seals.

9. LUBRICATING SYSTEM — Worthington cast-in manifolds, positive pressure lubrication to every running part.

10. ACCESSIBILITY — inherent in straight-line engine design, increased by large access doors on both sides of the engine frame.

11. WORTHINGTON FEATHER* VALVES: lightest, tightest, quietest ever made used in both compressor and scavenging cylinders.

"CUSTOM-BUILT" FOR ITS JOB

In addition to Worthington's experience covering half a century of building compressors for pipeline duty, more than seven years of intensive research devoted to developing the uniflo scavenging principles have gone into producing the TYPE UTC-16. The result is an Angle Gas Engine Compressor that meets the rigid requirements of gas pipeline service with more efficient use of fuel, cooler operation, improved accessibility and longer service life. For further facts about the uniflo TYPE UTC-16 — and proof that here, again, *there's more worth in WORTHINGTON* — contact your nearest Worthington Branch Office or the *Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.*

*Reg. U. S. Pat. Off.

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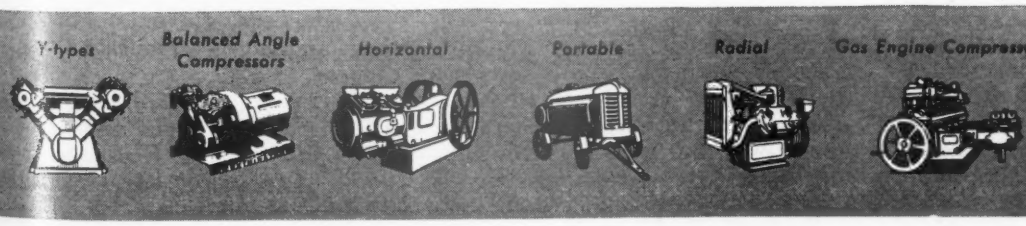


NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON

Texas Gas Transmission Line Goes Into Operation

The newest long-distance pipe line went into operation at the end of the year as Louisville Gas and Electric Company received the first delivery of natural gas from Southwest gas fields through the new 26-in. line of Texas Gas Transmission Corporation.

The new transmission line, built in less than eight months, is the longest constructed and put into operation during 1949. It will have an initial capacity of 304,000,000 cu ft a day when completed to Middletown, Ohio, this month. This will be increased in 1950 to 400,000,000 cu ft a day.

Deliveries also started in December to other utilities along the line, and to Texas Eastern Transmission Corporation this month for transmittal to subsidiaries of the Columbia Gas System and Consolidated Natural Gas Corporation, and to other northeastern utilities.

The new line, built at an approximate cost of $73,000,000, brings additional supplies of natural gas to utility customers in Tennessee, Kentucky, Illinois, Mississippi, Louisiana, and Arkansas in time to meet peak winter heating needs.

Louisville Gas and Electric received its first gas from Southwest fields as part of a contract under which it receives up ot 20,000,000 cu ft a day during the first year of the new line's operation, 30,000,000 cu ft a day during the second year, and 40,000,000 cu ft thereafter.

Other utilities will benefit by the start of operations of the new gas artery. Existing customers of Texas Gas serving more than 115 large and small communities will receive approximately 120,000,000 cu ft a day more than their present supplies. These utility customers include the Light, Gas and Water Division of the City of Memphis, Mississippi Power and Light Company, West Tennessee Gas Company, Southern Indiana Gas and Electric Company, Western Kentucky Gas Company, and Indiana Gas and Water Company.

New customers of Texas Gas that will receive natural gas for the first time when connections are completed to their systems from the new line include Kentucky Utilities Company (Paducah, Kentucky), Tennessee Gas Company, Corporation of Dyersburg, and Madison Utilities Corporation.

When the new line is completed Texas Gas will be ready to deliver to Texas Eastern initial minimum quantities of 123,000,000 cu ft a day, which will be increased by the addition of compressor horsepower to 235,000,000 a day by mid-1950. Texas Eastern will sell this amount through a new loop line in Ohio to the East Ohio Gas Company, serving Akron, Canton, Cleveland, and Youngstown, Ohio; The Manufacturers Light and Heat Company and the Ohio Fuel Gas Company, which serve numerous communities in Ohio, Pennsylvania, and West Virginia; and Philadelphia Gas Works, Consumers Gas Company, Allen-town - Bethlehem Gas Company, Harrisburg Gas Company, and National Gas and Oil Company.

Ten compressor stations with a total of 68,800 hp will push gas through the new line.

With completion of the new 800-mile line from Carthage to Middletown and addition of compressor horsepower, Texas Gas will have by the middle of 1950 a pipe line system totaling 2400 miles of pipe with total capacity of more than 650,000,000 cu ft of gas a day.

Gas Reserve Transfer Investigation Dismissed

The Federal Power Commission has dismissed the proceeding instituted October 26, 1948, involving an investigation of Panhandle Eastern Pipe Line Company's transfer of natural gas reserves to Hugoton Production Company, a subsidiary, in exchange for that company's stock. Panhandle, in turn, planned to distribute the stock to its own stockholders.

In its order dismissing the proceeding, the FPC pointed out that in a companion case the Supreme Court last June affirmed a lower court's ruling that denied the commission's motion for injunction to restrain Panhandle from the stock distribution pending the FPC's determination in the proceeding. The lower court subsequently entered an order dismissing the commission's complaint.

Servicing Arranged for Inland Marine Trade

Socony-Vacuum Oil Company, Inc., has arranged terminal facilities with the B. & M. Oil Corporation for servicing vessels of the inland marine trade.

The terminal is situated on the north side of the Morris Canal on the North River, Jersey City, and provides convenient facilities for harbor vessels where they may be supplied with Gargoyle marine lubricants, greases, diesel fuel, and bunker fuel. The facilities, which will dispense lubricating oils in bulk, will be available to shipping 24 hours a day, seven days a week, it is announced.

Contracts Awarded for Products Pipe Line

Award of two contracts for construction of an oil products pipe line from Boise, Idaho, to Pasco, Washington, is announced by C. E. Tinney, Jr., president of the Salt Lake Pipe Line Company, Salt Lake City, Utah.

Morrison-Knudsen Company, Inc., Macco Corporation, and Bechtel Corporation will build the section from Boise to Baker, Oregon. The northern portion of the line, from Baker to Pasco, will be built by Pacific Pipeline and Engineers, Ltd.

The installation will be a 240-mile extension of the Salt Lake-Boise line begun last year by the Salt Lake Pipe Line Company, a Standard Oil Company of California subsidiary, to transport oil products to the Northwest area from a refinery at Salt Lake City. The first leg, to Twin Falls, was opened to service early this month.

Construction of the Boise-Pasco section is scheduled to begin as soon as weather permits this Spring. It will serve Standard's bulk distributing plants at Ontario, Pendleton, and Baker in Oregon. In addition, terminal distribution facilities will be built at Pasco.

Total cost of the entire line and facilities from Salt Lake to Pasco will be approximately $13,500,000.

New Pipe Line Division For Macco Corporation

John MacLeod, president of Macco Corporation, announces that Signal Pipe Line Corporation of Long Beach, California, a wholly-owned subsidiary, was merged with the parent company at the end of the year, operating as the Pipe Line Division. B. M. Laulhere, Jr., continues in his capacity as manager.

The purpose of the merger, according to MacLeod, is to extend the company's pipe line services beyond its present scope. It is felt that this can be accomplished much more effectively by performing the utility, natural gas, and oil pipe line construction work as a division of Macco Corporation.

When the 24-year-old Signal Pipe Line Construction Company, was purchased by Signal Pipe Line Corporation last February, the present merger was being given serious consideration, said MacLeod. The interim operation has indicated the practicability of the merger.

Operations are continuing from offices at Signal Hill, El Monte, Colton, and Palm Village. Expansion plans call for additional offices at several strategic locations.

NEWS

FPC Dismisses Tennessee Application to Expand

The Federal Power Commission has dismissed Tennessee Gas Transmission Company's application for authorization to construct facilities to increase capacity of the pipe line connecting the company's main transmission line in Louisiana with the Carthage, Texas, gas field.

Tennessee now has a contract with United Gas Pipe Line Company for the latter company to transport over its Carthage line approximately 110,000,000 cu ft of gas a day for Tennessee.

In dismissing Tennessee's application, the commission found that since United has stated that it has no intention of canceling the contract, the FPC would be unable to make the requisite statutory finding that Tennessee is "able and willing properly to do the acts and to perform the service proposed."

Tennessee had proposed to increase the capacity of its own Carthage line to enable it to carry the gas now being transported by United. The construction program, estimated to cost $2,924,930, would have included installation of 4800 hp in new units at Tennessee's station No. 5, in Natchitoches Parish, Louisiana, at the eastern terminus of its Carthage line; and construction of about 24.2 miles of 30-in. line looping a portion of the company's main gas transmission line between compressor stations Nos. 5 and 6 in Louisiana.

Tennessee's contracts with United, dated November 1, 1945, and to remain in force for 20 years, fixes a transportation charge of $52,000 a month.

Tennessee's home office is in Houston, Texas, and United's is in Shreveport, Louisiana.

Allegany Gas Would Acquire Two Companies

The acquisition and operation by Allegany Gas Company of all the natural gas facilities of North Penn Gas Company and Dempseytown Gas Company has been proposed in an application filed with the Federal Power Commission.

The three companies, all of Port Allegany, Pennsylvania, submitted the proposal in a joint application, which also includes a request by the two selling companies for authorization to transfer their facilities to Allegany Gas.

North Penn's properties, which include about 298.8 miles of transmission lines, 253.6 miles of distribution lines, 122.5 miles of field and gathering lines, 6131 acres of production lands, and appurtenant facilities, are in McKean, Potter, and Tioga Counties, Pennsylvania.

Allegany would pay $3,500,000 and issue 23,000 shares of common stock, without par value, to North Penn for its facilities.

The Dempseytown Gas Company facilities involved in the proposed transaction include approximately 64.6 miles of pipe line, compressor stations, producing properties, etc.

Changes in Oklahoma Contracting Corporation

With a new line-up of officers familiar to the petroleum industry, announcement is made of the new Oklahoma Contracting Corporation, with T. A. Hester as president. Other officers are as follows: J. R. Horrigan, T. R. Jones, Paul R. Halbert, M. W. Staples, Ben O. Law, and W. H. Law. Officers will be maintained in the Mercantile Bank Building, Dallas, Texas, and the Commerce Building, Houston, Texas, with headquarters in Dallas. All the principals of the new Oklahoma Contracting Corporation have been connected with the oil and gas pipe line construction business for many years.

Under the new set-up the company is organized and equipped for six big-inch spreads and one spread for handling 12-in. pipe.

Hearing on Hope Natural Proposed Rate Increase

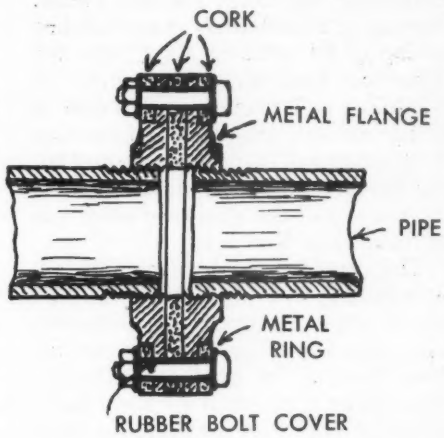
The Federal Power Commission and the Public Service Commission of West Virginia will hold a concurrent hearing beginning February 27 in Charleston, West Virginia, on Hope Natural Gas Company's proposed tariff changes, which would increase the company's rates for wholesale natural gas service by approximately $1,963,400 per year.

The proposed tariff changes, which were to have become effective last November 2, were suspended by the FPC October 31. Hope also applied to the West Virginia Commission for increases in its effective rates for sales of natural gas subject to the jurisdiction of that Commission.

The proposed increase in rates would be distributed among five of Hope's wholesale purchasers: East Ohio Gas Company, with an estimated increase of $1,373,706.33; The Peoples Natural Gas Company, $304,973.19; New York State Natural Gas Corporation, $137,159.96; Manufacturers Light and Heat Company, $147,080.46; and Mt. Morris (Pennsylvania) Gas Company, $492.66.

How To Make Piping Noiseless

Head-splitting noises are often transmitted through metal piping—water hammer noises, mechanics' blows, vibration noises, hissing



sounds, etc.—and yet but little is ever done about it except, once in a while, to cover the piping. That "helps," true enough, but the noises are merely "wrapped up," not eliminated. Metals and liquids are better transmitters of sounds than are air and other gases.

This question therefore naturally suggests itself: "Why not stop metal pipe noises by inserting isolated joints at occasional intervals?" It can be done by following the same method that is so successfully employed in isolating machinery vibration. This writer recently put the question to concerns who are in the vibration isolation business and he received favorable replies. It was suggested that screwed flanges of ample dimensions be used with broad and thick cork gaskets. Cork is an excellent material for vibration isolation. The bolts, too, should be cork isolated at each end and should be completely surrounded by isolating materials so that there will be no metal-to-metal contact in the joint whatever.

Such a joint should prove to be leakless under high pressures and temperatures, and it should effectively stop sound waves through the metal piping. Canvas and rubber joints are now successfully used on low pressure ventilating ducts for eliminating metal duct noises. The above method would eliminate noises from high pressure piping, so why not do it? It is entirely feasible and "vibration experts" agree with the writer. Joints of this type doubtless will make their appearance presently. —W. F. S.

▸ **Arey Phillips Construction Company,** Dumas, Texas, is laying a gathering system for Plains Natural Gas Company, consisting of 80 miles of 4 to 24-in. pipe. Work began January 10.

With the PIPE LINE CONTRACTORS

Dunn Brothers, 801 Mercantile Securities Building, Dallas, Texas, (stringing contractors), have finished stringing 90 miles of 30-in. pipe for Morrison Construction Company in Kentucky and Tennessee. The line is being laid as a loop to Tennessee Gas Transmission Company's system. Clifton Hammett was the superintendent in charge and the final field office was at Scottsville, Kentucky.

The company is also stringing approximately 700 miles of 30-in. pipe for El Paso Natural Gas Company. The latter is looping its line from Jal, New Mexico, to Blythe, California. The spread supervised by L. L. Rowland has moved its headquarters from Willcox to Benson, Arizona. The spread in charge of John Samuels still has its field office at Casa Grande, Arizona.

Oklahoma Contracting Corporation, 1210 Mercantile Bank Building, Dallas, Texas, as a joint venture with **N. A. Saigh Company,** has completed its part of the 62 miles being laid between the Red River and Sharon, Louisiana, for Texas Gas Transmission Corporation. In the East, 23 miles of 26-in. is being laid for Fish Constructors, Inc., acting as agents for Transcontinental Gas Pipe Line Corporation. This is in New Jersey and work has been slow. The section of line being constructed is from the west header of the Hudson River to the east bank of the Rahway River. The field office is at Edgewater, New Jersey. M. E. Shiflett is superintendent.

Oklahoma Contracting Corporation also is to lay 85 miles of 18-in. for the Portland Pipe Line Corporation, which company is paralleling its 12-in. line between Portland and Montreal. This work will not begin until May or June, however, when weather conditions will be more suitable.

Gulf Welding and Machine Company, Conroe, Texas, is laying a gathering system for Humble Oil and Refining Company in the Jourdanton, Imogene, and Charlotte fields of Texas. A total of 92 miles of 2 to 18-in. pipe will be laid.

Parkhill Truck Company, P.O. Box 1856, Tulsa, Oklahoma, (stringing contractors), is laying 234 miles of 12-in. pipe for Pacific Pipe and Engineers, Ltd., on work for Great Lakes Pipe Line Company between Tulsa and Kansas City, Missouri. The stringing contractor is working four spreads. One spread is working north from the Arkansas River at Tulsa, another is working out of Copan, Oklahoma, a third out of Chanute, Kansas, and the fourth is stringing pipe south from Morris, Kansas.

For Smith Contracting Corporation, 196 miles of 30-in. is being laid. This is the Transcontinental Gas Pipe Line Corporation job from Chatham, Virginia, to the Potomac River.

Sheehan Pipe Line Construction Company, 529 National Bank of Tulsa Building, Tulsa, Oklahoma, has completed 17 miles of 12-in. for Great Lakes Pipe Line Company between St. Paul, Minnesota, and Faribault, and shut down for the winter. This section is 52 miles in length. The 52 miles between Albert Lea and Faribault for the same company will not start until spring. The job for Mississippi River Fuel Corporation, 10 miles of 20 and 24-in. near East St. Louis, has been completed. Considerable pipe also is being laid at the Robinson, Illinois, refinery of Ohio Oil Company.

R. H. Fulton and Company, P.O. Box 1526, Lubbock, Texas, is moving a spread into Spartansburg, South Carolina, to begin laying 202 miles of 30-in. pipe for Transcontinental Gas Pipe Line Corporation in North and South Carolina and Virginia. A second spread will start in Virginia in April.

Considerable work also is being done for Northern Natural Gas Company in West Texas, western Oklahoma, and Kansas. This consists of 222 miles of 26-in., 155 miles of 20-in., and 50 miles of 20 and 24-in. The 50 miles of 20 and 24-in., near Liberal, Kansas, is under way. Work will begin on the 26-in. in March and on the 20-in. in May.

Knupp Construction Company, Inc., Great Bend, Kansas, is laying a gathering system in Finney County, Kansas, for Northern Natural Gas Company, consisting of 8.5 miles of 4, 6, and 8-in. pipe. Pat Gilmore is superintendent, with the field office at Ulysses. This company will be laying 4-in. gathering lines throughout 1950 for the Kaw Pipe Line Company. This work is being supervised by the company's Great Bend and Plainville organizations. Doyle Praytor is superintendent out of Great Bend, Ervan Fanshier is in charge of the Russell work, and A. D. "Dutch" Pegg is superintendent at Plainville.

Carl H. Dunn, Burkburnett Building, Fort Worth, Texas, is laying 22 miles of 8-in. crude oil line for the Pasotex Pipe Line Company from Colorado City, Texas, to a point 6 miles northeast of Snyder. The job is about half completed (January 30). The field office is at Colorado City and "Happy" White is superintendent in charge. This company recently finished 40 miles of 10-in. for Texas-New Mexico Pipe Line Company from Borden County to Colorado City.

O. C. Whitaker Company, 804 Dan Waggoner Building, Fort Worth, Texas, has approximately 20 miles of pipe in the ground (January 30) on the job it is doing for United Gas Pipe Line Company, which consists of 40 miles of 20-in. between Carthage, Texas, and Sterlington, Louisiana. The new line is being laid parallel to the existing system. Mud has slowed the job considerably. Two field offices have been established. Red McMenamy is superintendent of the spread working out of Ruston and Merl Tatom superintendent at Ringgold.

Eastern Construction Company, 1801 Mercantile Bank Building, Dallas, Texas, has begun construction on the 155 miles of 22-in. crude oil line it is laying for Mid-Valley Pipeline Company. The section is between Hornsby, Tennessee, and Russellville, Kentucky. Previously two river crossings had been installed, the Tennessee and Cumberland. The main field office is at Waverly. Fred Byers is superintendent and J. W. Arthur office manager.

Smith Contracting Corporation, 1410 Fort Worth National Bank Building, Fort Worth, Texas, is getting under way on 196 miles of 30-in. for Transcontinental Gas Pipe Line Corporation in Virginia, between Chatham and the Potomac River. The right-of-way is now being prepared. A field office has been opened at Altavista, Virginia. R. M. Jones is superintendent and Ben L. Mapes office manager.

Bechtel Corporation, Macco Corporation, and Morrison-Knudsen Company, Inc., as a joint venture, have contracted the section of line between Boise and Baker, Idaho, for the Salt Lake Pipe Line Company. This is an extension of the Salt Lake City-Boise line, which was opened as far as Twin Falls early in January.

Midwestern Constructors, Inc., 105 North Boulder, Tulsa, Oklahoma, has completed the 80 miles of 26-in. for Texas Gas Transmission Corporation in Jefferson County, Indiana, and Warren County, Ohio. The Transcontinental Gas Pipe Line Corporation job, 216 miles of 30-in. from Demopolis, Alabama, to Newnan, Georgia, was completed February 1.

Midwestern is engineering a gathering system for Plains Natural Gas Company, 80 miles of 4 to 24 in. Construction is being done by Arey Phillips Construction Company of Dumas, Texas. Midwestern has a field office at Liberal, Kansas, and Lyle S. DeWitt is chief inspector.

Mary Construction Company, Inc., Box 205, Cape Girardeau, Missouri, will begin work about June 1 on 111 miles of 26-in. for Northern Natural Gas Company. This section will loop the company's line from a point near Ogden, Iowa, to Farmington, Minnesota.

Vaughn and Taylor Construction Company, Inc., Box 1351, Wichita Falls, Texas, is doing several jobs for Phillips Pipe Line Company and Phillips Petroleum Company. Three 8⅝-in. loops totaling 25.44 miles are being laid in the vicinity of Ottawa, Kansas, and were 75 per cent completed January 25. Sixteen miles west of Kansas City the Kansas River is being crossed with 1700 ft of 8⅝-in. pipe. D. D. Vaughn is in charge. These two jobs are for Phillips Pipe Line Company. For Phillips Petroleum Company, approximately 25 miles of 2 to 24-in. pipe is being laid in the Fullerton field of Andrews County, Texas. Jess Moore is the superintendent and the work was 50 per cent completed January 25. In Sherman County, Texas, construction of 5.5 miles of 24-in. line began January 30. Near Crane, Texas, an indefinite amount of construction is being done for this company with Jess Moore in charge.

Pacific Pipe and Engineers, Ltd., 2268 East Firestone Boulevard, Los Angeles, California, has been given a contract to lay pipe from Baker to Pasco, Idaho, for the Salt Lake Pipe Line Company. Work will begin in the spring as soon as weather permits. This is part of a 240-mile extension of the Salt Lake City-Boise line begun last year. The first section, Salt Lake City to Twin Falls, was opened to service in January.

This contractor is also constructing approximately 300 miles of products line for Great Lakes Pipe Line Company between Tulsa and Kansas City, paralleling the existing system.

A. C. Holder Construction Company, 2615 East Admiral Place, Tulsa, Oklahoma, is at work on 72.33 miles of 12-in. line for Great Lakes Pipe Line Company. The latter is paralleling its line between Minneapolis, Minnesota, and Des Moines, Iowa, and this is part of that work.

Williams Brothers Corporation, National Bank of Tulsa Building, Tulsa, Oklahoma, will construct the section between Regina and Gretna of Interprovincial Pipe Line Company's system. The overall line will extend 1150 miles from Edmonton, Alberta, to Superior, Wisconsin. For the Great Lakes Pipe Line Company, the contractor is installing a Mississippi River crossing at South St. Paul, Minnesota.

Bishop and Lock Construction Company, 503 Magnolia Building, Dallas, Texas, has just completed the work it has been doing for Magnolia Pipe Line Company at the Brazos River, near Kopperl, Texas. This consisted of laying four lines, two 8-in. and two 10-in., which will be beneath the Whitney Dam. Johnny Walden finished as superintendent of this spread while Barney Hall moved out to Snyder field, Texas, where 13 miles of 6 and 8-in. lines are being laid for Magnolia from its Scurry station.

O. L. Burden Construction Company, Box 5216, Tulsa, Oklahoma, formerly at Wichita Falls, Texas, has purchased the Bill Morrison Construction Company, and is now laying 64.63 miles of 12-in. line for the Great Lakes Pipe Line Company. This is part of the looping project between Minneapolis, Minnesota and Des Moines, Iowa.

Latex Construction Company, 2707 Ferndale Place, Houston, Texas, has the following construction work under contract:

Mississippi River crossing consisting of two 16-in. gas lines for Tennessee Gas Transmission Company South of the Greenville Bridge. Work is in progress. J. A. Cantrell is superintendent, and Jack Slovack the welding foreman; headquarters are at Greenville, Mississippi, and Lake Village, Arkansas.

For Mid-Valley Pipeline Company, 120 miles of 20-in. crude oil line from Haynesville, Louisiana, to the Mississippi River north of Lake Providence, Louisiana. This job is being done with two spreads. One spread is located at Farmerville, Louisiana; F. A. Silar, general superintendent; W. A. Briley, spread superintendent; C. V. Oliver, office manager. The other spread is at Haynesville, Louisiana; W. H. Hayes, superintendent; M. L. Thompson, assistant superintendent; A. E. Stremmel, office manager.

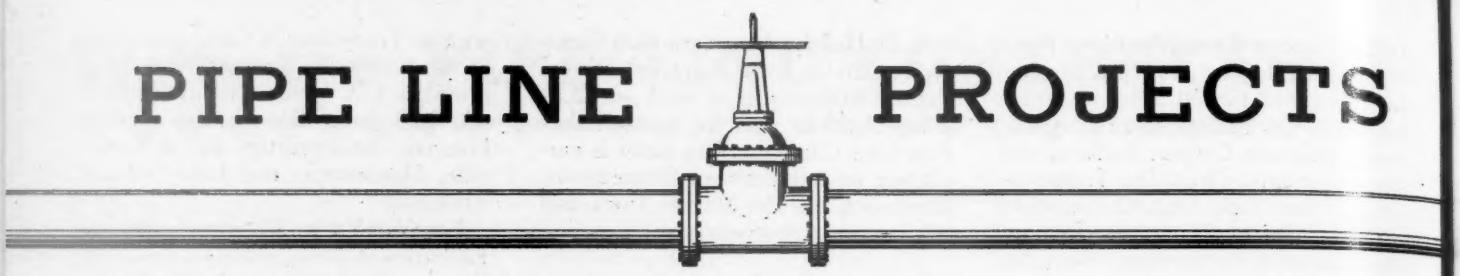
For Mid-Valley Pipeline Company, 41 miles of 12-in. lateral crude oil line from the vicinity of Delhi, Louisiana, to Lake Providence, Louisiana. E. C. Norris is general superintendent; R. E. Thornton, spread superintendent; R. J. Axsom, office manager. Headquarters are at Lake Providence.

Rearrangement of tank farm piping for Humble Pipe Line Company at Crane Tank Farm. J. B. Latham is superintendent, and W. E. Bayles, office manager. Headquarters are at Crane, Texas. Work is just starting.

Dumas Pipe Coating Company, P. O. Box 1351, Wichita Falls, Texas, (coating contractors), is coating 5.5 miles of 24-in. pipe for Vaughn and Taylor Construction Company, which will be used in Sherman County, Texas, on a Phillips Petroleum line. L. B. Lingle is superintendent.

Bechtel-Price-Conyes, 220 Bush Street, San Francisco, California, is constructing 506 miles of 34-in. for Pacific Gas and Electric Company from Topock, Arizona, to Milpitas, California. R. L. Bowman is general superintendent and Steve Valline office manager.

PIPE LINE PROJECTS



Southern Natural Would Lay 803 Miles Line

Southern Natural Gas Company, of Birmingham, Alabama, has applied to the Federal Power Commission for authorization to construct natural gas facilities that will expand the capacity of its pipe line system by 109,000,000 cu ft per day to a total daily capacity of 529,000,000 cu ft. Estimated cost of the construction program is $32,520,000.

The company said the proposed facilities would provide additional capacity to meet the increasing demands of its present market area, which includes Alabama, Georgia, Louisiana, and Mississippi. In addition, Southern Natural said its proposed facilities will provide capacity for the delivery of gas for resale in 38 communities in Alabama, Mississippi, Georgia, and South Carolina.

The proposed project includes construction of a total of approximately 803 miles of pipe line, including main line additions, branch line loops, and connecting lines in Texas, Louisiana, Mississippi, Alabama, Georgia, and South Carolina; and installation of 19,200 in compressor horsepower. The 803 miles of pipe line includes 496 miles of new high pressure lines extending from the Gwinville (Mississippi) gas field to Aiken, South Carolina.

Expansion Proposed by Eastern Gas Companies

New York State Natural Gas Corporation has filed two applications with the Federal Power Commission, both proposing construction of pipe line facilities designed to make additional natural gas available to consumers in Pennsylvania and New York, including New York Power and Light Corporation and Central New York Power Corporation.

Meanwhile, the latter two companies have filed with the FPC a joint application for authorization to construct facilities to receive the gas from New York State Natural for delivery to markets in New York State.

New York State Natural is proposing in one application to enlarge the transmission and underground storage capacity of its system to keep pace with consumers' requirements. This project includes construction of 53.5 miles of 16-in. loop line in Pennsylvania extending from a compressor station in Greene County to another station in Westmoreland County. In addition, the company proposes to replace several sections of pipe at two storage pools, one in Tioga County, Pennsylvania, and the other in Potter County, Pennsylvania.

In its second application, New York State Natural sets forth plans for enlargement of its system and underground storage capacity to enable it to deliver additional gas to Central New York Power and to New York Power and Light for distribution in Albany and other districts now served by them in New York State.

This proposed construction program includes a 164-mile line extending from Dryden, New York, to the Albany area; a 56-mile line from the Dryden terminus of the proposed Albany line extending southerly to the Tioga County, Pennsylvania, storage pool; and acquisition of additional leasehold and other property rights necessary to develop a new storage pool. Seven miles of pipe and a 5000-hp compressor station would be installed at the new storage pool.

The joint application filed by Central New York Power and New York Power and Light outlines plans for construction of 10.4 miles of pipe lines by Central and 15.3 miles by New York Power. These two companies were consolidated on January 5, 1950. Central New York Power's home office is in Syracuse; New York Power's in Albany, and New York State Natural's in New York City.

Frontier Seeks Permit For Products Pipe Line

Frontier Refining Company, Denver, Colorado, has filed an application with the Nebraska Railroad Commission asking permission to construct a products pipe line from its refinery at Cheyenne, Wyoming, either to Omaha or Lincoln, possibly both.

In its application, the company says that with an ultimate proposed capacity of 200,000,000 bbl a year, such a line would make possible shipments of refined products through a 6 or 8-in. line to terminals at Sidney, North Platte, and Grand Island in addition to Omaha and Lincoln.

Eastern Natural Withdraws New England Application

The Federal Power Commission has issued an order permitting Eastern Natural Gas Corporation to withdraw its application which proposed construction of a $28,000,000 natural gas pipe line project extending from a point near Phoenixville, Pennsylvania, to an eastern terminus near Boston, Massachusetts.

Eastern had proposed to construct the main 292-mile, 24-in. line and about 200 miles of sales lateral lines. The project was designed to have an initial capacity of approximately 200,000,000 cu ft of natural gas per day for sale at wholesale to public utilities or municipalities operating distribution systems in communities in New England.

Eastern Natural has its headquarters in Washington, D. C.

FPC Continues Hearing On Gas Applications

Federal Power Commission Presiding Examiner George T. Liddell has set aside his order directing the hearing to reconvene February 6 in the proceeding involving proposals to construct pipe line facilities that would carry natural gas to Georgia, Florida, South Carolina, and Alabama.

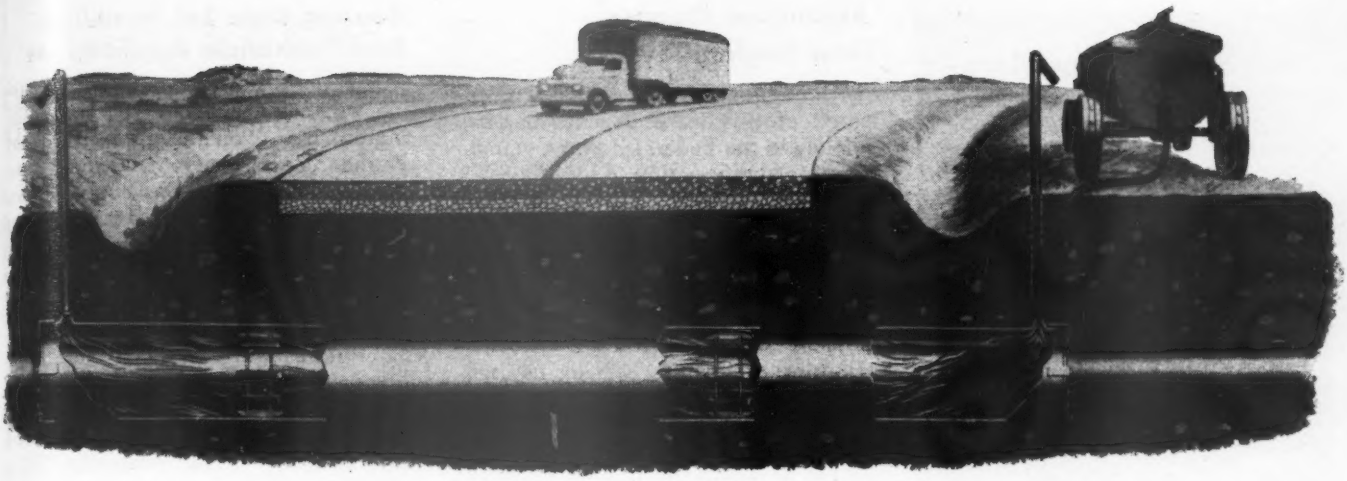
The examiner ordered that the hearing will stand continued subject to further action of the commission. The applications were filed by Atlantic Gulf Gas Company, Southern Natural Gas Company, and United Gas Pipe Line Company.

Both Southern Natural and Atlantic Gulf are proposing to construct facilities designed to serve areas, some of which are substantially the same, in four southern states, where United Gas is seeking authorization to build a line for delivery of gas to Atlantic Gulf.

A motion to dismiss all three applications was filed December 21 by the National Coal Association, United Mine Workers of America, and associated parties.

Hearings on the applications began last August 22 and total 19 days.

United and Atlantic Gulf are subsidiaries of United Gas Corporation with main offices in Shreveport, Louisiana. Southern Natural's home office is in Birmingham, Alabama.



Cutaway of highway crossing showing application of NO-OX-ID Casing Filler. Here 24" pipe has been pushed through a 28" casing; casing bushings assembled and sealed at the ends. Filler is feeding from the portable melting kettle directly into the lower casing vent coupling.

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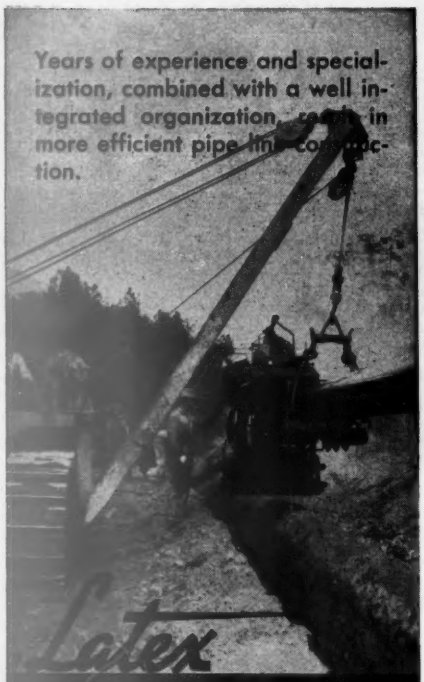
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Algonquin Proposes New England System

Algonquin Gas Transmission Company, of Boston, Massachusetts, has applied to the Federal Power Commission for authorization to build a $27,549,100 natural gas pipe line system in the New England area.

The proposed project, which would have an initial delivery capacity of approximately 250,000,000 cu ft a day, would carry natural gas to distributing companies serving communities in Connecticut, Massachusetts, Rhode Island, and New Hampshire. The company said that whenever it proves economically feasible to do so, it will apply for authorization to extend the service to Vermont and Maine.

The pipe line system would include a main 276-mile line extending from a point of connection with Texas Eastern Transmission Corporation's facilities near Lambertville, New Jersey, to a point in the Boston area. Algonquin said it has entered into an arrangement with Texas Eastern for that company to undertake to supply the natural gas requirements of the proposed New England project.

In addition to the main line, Algonquin plans to build approximately 492 miles of laterals, and a compressor station near Middletown, Connecticut. The company said the initial delivery capacity of the system could be increased by at least 100,000,000 cu ft a day by the addition of another compressor station, and extra units at the proposed Middletown station.

Texas Eastern, the company from which Algonquin plans to obtain its natural gas requirements, now has an application pending before the commission proposing construction of pipe line facilities that would make available up to 200,000,000 cu ft of gas a day to the New England area. However, Algonquin said that under its arrangement with Texas Eastern, the latter company will either file a new application or amend its existing application by requesting FPC authorization to build facilities necessary to supply Algonquin.

In another proceeding pending before the commission, Northeastern Gas Transmission Company, also of Boston, is seeking authorization to build a 511-mile pipe line system for transportation and sale of natural gas at wholesale in the six New England states. Northeastern would obtain its gas supplies from Transcontinental Gas Pipe Line Corporation and Tennessee Gas Transmission Company. An FPC hearing in this matter will begin March 7 in Washington, D. C.

Hearing Date Set Trunkline And Panhandle Applications

A Federal Power Commission hearing will begin February 27 in Washington, D. C., on the applications of Panhandle Eastern Pipe Line Company and Trunkline Gas Supply Company, which are seeking authorization to construct pipe line facilities to carry additonal natural gas to markets in the Midwest.

Trunkline is proposing to construct a 740-mile Louisiana-to-Illinois pipe line designed to carry about 250,000,000 cu ft of gas a day for delivery to Panhandle. Estimated overall cost of this project is approximately $85,000,000.

Panhandle, which is seeking authorization to expand its system capacity to enable it to transport the 250,000,000 cu ft of gas, plans to build 170 miles of pipe line and to install 16,000 hp in compressor units at existing stations. These facilities, to be situated in Illinois, Indiana, and Michigan, are estimated to cost $14,689,500.

Trunkline's principal office is in Washington, D. C., and Panhandle's is in Kansas City, Missouri.

Phillips to Extend Line to Denver

K. S. Adams, president of Phillips Petroleum Company, has announced plans for the early extension to Denver of the present 200-mile petroleum products pipe line now in operation between the Phillips Oil Company refinery at Phillips, Texas, and LaJunta, Colorado. This extension will be 6 in. in diam and 155 miles long and will be owned 85 per cent by Phillips with the remainder owned by Shamrock Oil and Gas Corporation.

It is planned to complete the line and a terminal at Denver during this year. When the Borger-LaJunta section was constructed in 1947, the extension to Denver was deferred because of material shortages.

When completed, it will be one of the most modern pipe lines in the world. It will have latest methods used on underground pipe to combat soil corrosion, modern electrical pumping equipment, latest type safety devices to control high pressures, and many other new pipe line features.

The terminal at Denver will be the end of the pipe line. Storage tanks will be constructed here to handle more than 5,000,000 gal of gasoline and 300,000 gal of liquefied petroleum gases.

With the completion of these facilities, more than 8000 bbl of petroleum products can be moved daily from Phillips refinery in Texas to Denver.

PROJECTS

Consolidated Hearings On Eight Applications

The Federal Power Commission has scheduled consolidated hearings to begin March 7 in Washington, D. C., on eight applications, three of which involve natural gas service to the New England area.

Three of the other applications propose the construction of facilities to transport natural gas for resale in northeastern Ohio, one proposes service in New York State, and the final application involves the sale of natural gas in West Virginia. Tennessee Gas Transmission Company, Houston, Texas, would supply all or part of the gas in all of the cases.

The proposals to serve New England involve applications filed by Tennessee, Transcontinental Gas Pipe Line Corporation, Houston, and Northeastern Gas Transmission Company. Tennessee and Transcontinental propose, among other things, to construct facilities for the purpose of supplying natural gas to Northeastern, which in turn is seeking authorization to construct a pipe line system for the transportation and sale of natural gas at wholesale in the six New England states.

The applications to build facilities for service in Ohio were submitted by Erie Gas Service Company, Inc., Lake Shore Pipe Line Company, and Grand River Gas Transmission Company. All three companies propose to purchase natural gas from Tennessee at a connection in western Pennsylvania.

In the New York State proceeding, New York State Natural Gas Corporation has asked the FPC to authorize extensions and additions to its present transmission system and to its underground storage capacity, and the sale and delivery of natural gas to Central New York Power Corporation and New York Power and Light Corporation (recently consolidated as Niagara Mohawk Power Corporation) for distribution in Albany and other areas now served by them in New York State. The plan calls for Tennessee to supply gas to New York State Natural.

Tennessee, in the final application involved in the eight consolidated proceedings, has applied to the FPC for authorization to construct and operate a sales meter station at a point on its main transmission line in Kanawha County, West Virginia, and to sell and deliver at that point 5,000,000 cu ft of natural gas per day to Godfrey L. Cabot, Inc., for resale by the latter in Fayette and Kanawha Counties, West Virginia.

Gas Line Planned to Serve Virginia Cities

Natural Gas Service Corporation has applied to the Federal Power Commision for authorization to construct 92 miles of pipe line in Virginia to carry natural gas to Petersburg, Hopewell, and Richmond.

The company also is seeking authorization to establish an interconnection in the Buckingham, Virginia, area with the Texas-to-New York City pipe line now under construction by Transcontinental Gas Pipe Line Corporation and to obtain a supply of natural gas from the latter company at that point.

The proposed new line would extend from the Buckingham connection to the corporate limits of Richmond and Hopewell. The company said the system would have a calculated daily market delivery capacity of 80,000,000 cu ft.

Proceedings involving two other proposals to serve Virginia market areas, including Richmond, are now in progress before the commission. These applications were filed by Commonwealth Natural Gas Corporation and Piedmont Natural Gas Corporation.

Natural Gas Service Corporation presently has its headquarters in Washington, D. C.

Northern Natural to Add 597 Miles

The Federal Power Commission has authorized Northern Natural Gas Company, of Omaha, Nebraska, to construct pipe line facilities that will expand the capacity of its natural gas transmission system north of Kansas by 130,000,000 cu ft per day to a total of 600,000,000 cu ft.

The construction program, which the company expects to complete in October, 1950, includes approximately 597 miles of 20 and 26-in. pipe, and installation of 35,200 hp in compressor capacity. Estimated overall cost of the project is $51,840,000. The new pipe line looping will be built in Texas, Oklahoma, Kansas, Nebraska, Iowa, and Minnesota.

The company said the increased capacity is required to supply the increasing requirements of the residential and small volume commercial and industrial loads in the communities presently being served by its gas utility customers. Northern Natural's market area north of Kansas includes Nebraska, Iowa, Minnesota, and South Dakota.

The commission directed the company to begin construction by May 1, 1950, and to complete the project by next December 31.

Hearing Scheduled on Texas Illinois Proposal

The Federal Power Commission has scheduled a hearing to begin February 20 in Washington, D. C., on the application of Texas Illinois Natural Gas Pipeline Company, which is proposing to construct a 1254-mile natural gas pipe line from Texas to Illinois.

In addition to the main line, which would originate southwest of Houston, Texas, and extend to the Joliet, Illinois, area, the company plans to build a 58-mile line from Joliet to Volo, Illinois, and to establish a connection with the proposed facilities of Piedmont Natural Gas Corporation, at or near Greenville, Mississippi. Estimated cost of the project, excluding any facilities necessary for deliveries to Piedmont, is $120,942,000.

Texas Illinois proposes to deliver an average of 275,000,000 cu ft of natural gas per day to Piedmont, which now has an application pending before the commission for authorization to build a pipe line from Texas to the Carolina-Virginia region.

In addition, Texas Illinois is planning to sell gas to utility companies which are now buying from Natural Gas Pipeline Company of America and its affiliate, Chicago District Pipeline Company. Texas Illinois proposes to meet the requirements of these customer companies over and above the amounts now available to them from Natural and Chicago District and would make deliveries through the existing systems of these two companies. Sales of gas to other utilities operating in the general territory adjacent to the proposed new line are also planned by Texas Illinois. The main office is in Chicago.

New Portland-Montreal Line Starts in May

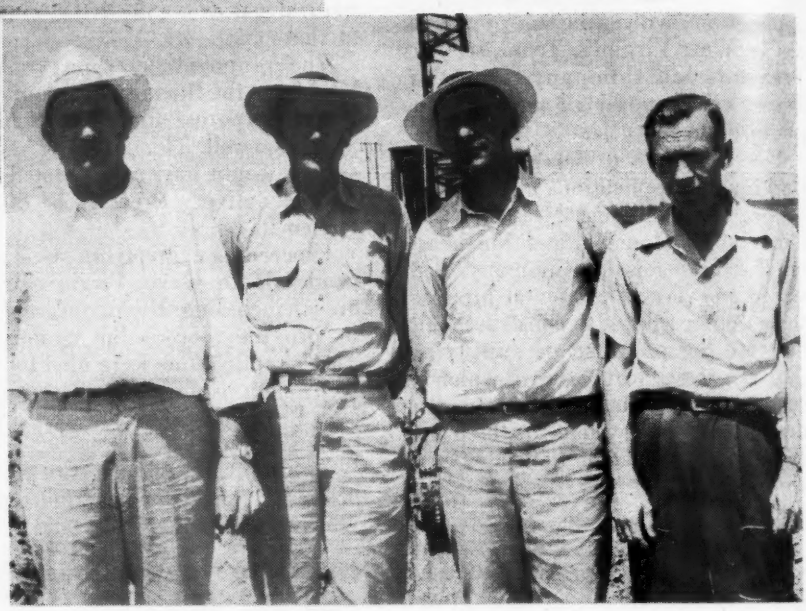
Construction will begin in May on a second line from Portland, Maine, to Montreal, Canada, by Portland Pipe Line Corporation, according to F. C. Schultz, president of Portland. The line is expected to be completed in November. Cost will be approximately $15,000,000. According to Schultz, the new line will increase present capacity to 140,000 bbl a day from 63,000 bbl.

FPC Hearing Postponed

The Federal Power Commission has postponed until February 20 the hearing previously scheduled to begin January 18 in Washington, D. C., in the proceeding involving the suspension of Atlantic Seaboard Corporation's proposed natural gas tariff.

Pictorial

Two wide gauge TL Hoes work back to back on the 57-mile long Poplar Bluff, Missouri loop of the Mississippi River Fuel Company's 24-in. natural gas line. Mary Construction Company of Cape Girardeau, Missouri, has the contract and uses five Lorain hoes on this job in rocky, hilly going like this.



Tennessee Gas Transmission Company 62 miles of 24-in. and 30-in. between Refugio and Victoria, Texas. (Contract let to H. C. Price Company and Bechtel Corporation; H. C. Price Company handling construction directly.) Looking over the job are: C. S. LeNoir, general superintendent, H. C. Price; Joe Ham, chief inspector, TGT; G. A. Reutzel, spread superintendent, and L. L. McMillon, pilot for the Price Company.

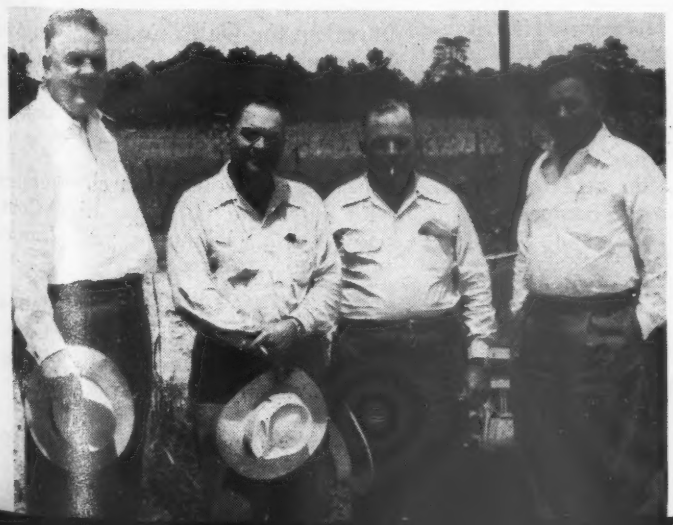
Bending Crew reaches top of third hill from Ohio River crossing near Madison, Indiana. This picture is taken from atop third hill looking back toward Ohio River. Note construction equipment parked sideways on hills. (Schedule No. 10, Texas Gas Transmission Corporation, Midwestern Constructors, Inc., R. C. Stanley, Superintendent.)

Tough going on the third spread of the Transcontinental Gas Pipe Line, between Bassfield and Collins, Mississippi. Even though mounted on half-tracks, it was still necessary to give the Lincoln welders a tow to get them into position on the line through this mire. Contractor is Wunderlich and Griffis of Tulsa, Oklahoma.

H. W. Wilker, right, of Sauk Centre, Minnesota, receives from D. L. Rankin of Chicago, manager of the products pipe line department of Standard Oil Company (Indiana), special award for having worked in department since it was founded 10 years ago.

S. S. Sovac Astral glides down shipway of Sun Shipyard.

Martin Wunderlich, Wunderlich & Griffis Construction Company, Tulsa, Oklahoma; Ellis Dunn, Dunn Brothers, Dallas, Texas; G. G. Griffis, Wunderlich & Griffis, and Jack Hodges, Morrison Construction Company, snapped on the Transcontinental Gas Pipe Line Corporation job.



TRANSPORTATION PERSONALS

Hobart G. Mariner

Hobart G. Mariner, an engineer, has been appointed superintendent of the Missouri division of the Stanolind Pipe Line Company. J. R. Polston, general manager made the announcement. He assumed his new post February 1.

Mariner succeeds E. W. Young who retired January 1 after 32 years' service with the company. Mariner during the last eight months has served at Casper as assistant superintendent of the Wyoming division under Area Superintendent R. R. Strand. His new headquarters will be the company's division office at Carrollton, Missouri.

Mariner will have charge of all Stanolind Pipe Line Company's operations in Missouri, including the "hub," the Freeman, Missouri, station, where the Wyoming line and the Gulf Coast-Chicago lines join. The line from LaPlata, Missouri, to refineries in the St. Louis area also will be under his supervision. The company's main north-south line enters Missouri from Kansas in Cass County, a few miles south of Kansas City, and crosses the state in a northeasterly direction to the southern tip of Iowa. There is a delivery line from Freeman north to a refinery at Sugar Creek.

In addition to the big pump station at Freeman, there are stations at Carrollton, LaPlata, at Center in Ralls County, and at Auburn in Lincoln County in the company's Missouri system. Stanolind Pipe Line can deliver approximately 345,000 bbl of crude oil daily through its Missouri lines to refineries at Kansas City and St. Louis, and through an extension of its main lines through Illinois to refineries in the Chicago area. The company gathers the crude oil for these deliveries in Wyoming, Kansas, Oklahoma, Texas, and New Mexico. It employs about 2800 persons and operates 11,300 miles of lines in 10 states.

Mariner joined Stanolind in 1940 as a draftsman and instrument man. Before that he was employed as a junior engineer with the Lago Petroleum Corporation in Maracaibo, Venezuela. Previously he held positions with the Kansas State Highway Commission and the Phillips Petroleum Company. During the war he served as a naval lieutenant, commander of a naval construction battalion maintenance unit in the South Pacific.

On his return to the company in 1945, he was made a specifications engineer, participating in Stanolind Pipe Line Company's $88,000,000 postwar modernization program. In 1947 he became head of the hydraulics section of the engineering department in the Tulsa headquarters. After a short period as an area engineer in West Texas, with headquarters in Lubbock, he was promoted to assistant area superintendent and transferred to Casper, Wyoming.

A native of Wilson County, Kansas, Mariner was born November 9, 1914, near the company's right-of-way in the eastern section of the state. He was graduated with honors from Kansas State College, receiving an engineering degree. Later he attended a course in elementary refining at Phillips Petroleum Company's vocational school. Mr. and Mrs. Mariner have one child.

Alvin E. Hurstad, formerly local superintendent at Spirit Lake, Iowa, for Peoples Natural Gas Company, has been made district manager at Wymore, Nebraska, succeeding **Herman J. Trauernicht,** retired. **Warren Ruskell,** who has been a utility man at Webster City, Iowa, takes over Hurstad's old job.

Melvin W. Pettit, after 10 years as natural gas pipe line engineer with the Federal Power Commission, has resigned to enter private industry as a gas consultant. His address is Leigh Mill Road, Vienna, Virginia.

E. W. Young, area superintendent of Stanolind Pipe Line Company's Missouri Division, has taken optional early retirement after a period of 32 years' service with the company.

Hugh Roberts has been selected to occupy the newly created post of assistant controller of Northern Natural Gas Company and Peoples Natural Gas Company. He has been with Northern Natural since 1945.

J. B. Spangler, who as an engineer with Ford, Bacon, and Davis, assisted in the design and construction of the Michigan-Wisconsin Pipe Line Company system, resigned recently. He is now with the Transcontinental Gas Pipe Line Corporation at Houston, Texas.

Duncan K. Foulds and **Monty G. Martin** are recent additions to the Shreveport, Louisiana, staff of Texas Gas Transmission Corporation. Foulds is a natural gas engineer and has been with Transcontinental Gas Pipe Line Corporation. He is a graduate petroleum engineer from the University of Texas and served four years in the armed forces. Martin, a geologist, has been employed by Carter Oil Company. He is a graduate of Oklahoma University and served three years in the Army Engineers Corps.

The new Shreveport office of Texas Gas will be concerned with all phases of gas supply, including gas proration, engineering, estimating of old and new reserves, deliverability studies, and contracting of new supplies. Head office of the company is at Owensboro, Kentucky.

Frank A. Canada, Jr., Pacific Pumps, Inc., is a new member of The Pipe Liners Club of Tulsa. Other recent new members include **Charles Wheatley,** Charles Wheatley Company; **Samuel E. Bosley,** Owens-Corning Fiberglas Corporation; **W. C. Wadsworth,** Walworth Company; **Herman A. Wienecke,** Gaso Pump and Burner Manufacturing Company; **John R. Sally,** Republic Steel Corporation; **Art Ray,** Gulf Refining Company, Pipe Line Department, and **James A. Graves,** Stanolind Pipe Line Company.

Everett Seabury, vice president of Grafe-Callahan Construction Company, is a recent arrival in Dallas, Texas.

John H. Frye, construction superintendent for Walco Construction and Engineering Company, Tulsa, Oklahoma, was the January speaker before The Tulsa Pipe Liners Club. His subject was "Army Pipe Lines."

Frank Coryell, research engineer with Interstate Oil Pipe Line Company, Tulsa, Oklahoma, passed away January 6.

Charles E. Clardy, chief station engineer at Oregon station, near Cody, Wyoming, for Stanolind Pipe Line Company, retired recently.

NEWS

Foreign Imports Cut

Some of the U. S. companies that have been importing oil from the Middle East have voluntarily agreed to cut their imports effective February 1.

The Texas Company was first, announcing that it has cut foreign imports 17 per cent. The cut will result in importation of 62,250 bbl of crude and 3500 bbl of residual fuel oil daily, the company has reported. This report of Texas' planning to cut its imports came three days after oil allowables were cut in Texas for the 10th time since December, 1948. Previously The Texas Company had planned to import 72,425 bbl of foreign crude and 7600 bbl of residual fuel oil daily.

Shell Oil Company was the second big company to announce reductions of imports, when a company spokesman announced that the company would cut its oil imports in 1950 25 per cent below the level of 1949. The 25 per cent cut, Shell estimates, means 1950 imports will come to approximately 15,000 bbl a day.

Following the chain reaction set off by The Texas Company, came announcement that Standard Oil Company (New Jersey) will cut its imports for the first half of 1950. The company plans to import crude oil at an average rate of 75,000 bbl daily, comparing with previous plans to import 88,000 bbl daily during the first quarter of the year, and 90,000 bbl daily during the second.

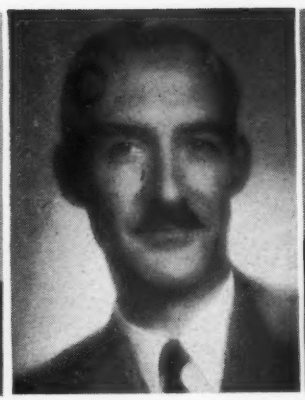
Socony-Vacuum Oil Company, Inc., later joined the list, and announced plans to reduce its imports by 5000 bbl a day. Socony had previously announced it would import about 74,000 bbl. daily. The company stated about half the scheduled imports cannot be altered due to 1947-48 contracts.

The action of these oil companies in voluntarily cutting their imports is expected to lessen the strength of the drive in Congress for statutory restrictions on oil imports.

Engineer Survey Deadline Set

March 15, 1950, has been announced as the closing date for the nation-wide survey of selected engineering personnel now being sponsored by the Engineers Joint Council for the U. S. Office of Naval Research. To date over 60 per cent of the 115,000 questionnaires sent to full members of 18 national engineering societies have been answered. After processing by The American Society of Mechanical Engineers, contracting agent under an ONR agreement, the questionnaires will be kept in Washington as a source file of key engineers and scientists.

John Sherborne



H. G. Doll

Tom Orr

AIME Meets In New York

A program that explains the petroleum production industry's economic and technological position is being featured at the 1950 annual meeting of the American Institute of Mining and Metallurgical Engineers, being held in New York City. John Sherborne, Union Oil Company of California, Los Angeles, the branch chairman for 1950, and Paul Andrews, Signal Oil and Gas Company, Los Angeles, are presiding over a seminar discussion on the relationship of production technology to the present and future requirements of the industry.

H. G. Doll, director of research, Schlumberger Well Surveying Corporation, Ridgefield, Connecticut, will discuss "MicroLogging"* in a technical session, and Tom Orr, executive secretary of the Kansas Independent Oil and Gas Association will talk on "Whose Business is This?", a report on the adoption, or lack of adoption of the Hoover Commission Report.

Sun Oil Sued In Court

Sun Oil Company, Philadelphia, Pennsylvania, has been charged with anti-trust law violations in the sale and distribution of gasoline and automobile accessories. The Justice Department, which made the charge, has accused Sun of compelling some 10,000 independent operators in 18 states and the District of Columbia to enter into exclusive purchasing contracts for Sunoco products, manufactured by Sun. The suit alleges that contracts require these service stations to purchase their gasoline, motor oils, and other petroleum products and automobile accessories from Sun, and to refrain from making any similar purchases from any Sun competitor. The suit asked the Philadelphia court to cancel these contracts and to enjoin the Sun Company from employing any "coercive devices" in dealing with its filling station outlets.

* Trade Mark.

Depletion Exemptions Hit

Oil producers throughout the different sections have gone on record as disagreeing wholeheartedly with the President's tax message statements that the oil industry enjoys excessive depletion exemptions.

Under the present law, oil companies are allowed to deduct 27.5 per cent of gross income to recover their original investment before their reserves are exhausted. Allowances are restricted to 50 per cent of a taxpayer's net income.

New Flow Rates Set

Unlike Oklahoma and Louisiana, Texas crude oil production allowable was cut for the month of February. The daily output for this month in Texas was set at 2,052,174 bbl daily, compared to 2,088,400 in January. Members of the Railroad Commission stated that only anticipation of continued heavy withdrawal from current crude stocks prevented further cutback. Most Texas fields will operate only 15 days in February, with the East Texas field producing on 13 days. The January schedule was 17 and 15 days respectively.

In Louisiana the Conservation Commission set the maximum allowable production at 577,600 bbl daily, 5388 over the January quota. In Oklahoma the amount was set at 407,975 bbl daily, an increase of 40,983 bbl over the January rate. Eighteen new pools or zones were added to the allocated list.

API Sets Meeting Date

The Eastern district of the division of production of American Petroleum Institute will hold its spring meeting in Cleveland, Ohio, April 26-28. The sessions will be held in Hotel Cleveland. R. W. French, vice president of Sohio Petroleum, Cleveland, has been appointed chairman of the general arrangements committee.

Foreign visitors attending the January meeting of Houston Nomads shown are: D. V. Smith, Reynosa, Mexico; W. D. Koonze, Bogota, Colombia; T. R. Whittaker, Anglo-Saxon Oil, London; W. J. Nifelt, B. P. M., The Hague; Helmy Elmasri, Anglo-Egyptian Oilfields, Cairo, Egypt; C. R. Summers, Caracas, Venezuela; and O. L. Nuernberger, Houston. New officers are, Edmond L. Lorehn, Cameron Iron Works, president; Wayne Rives, Oil and Gas Journal, vice president; Tracey T. Word, Jr., Weco, secretary-treasurer; E. F. (Salty) Baldwin, Hughes Tool, assistant secretary-treasurer; Lawrency J. Kelley, Hillman-Kelley, sergeant-at-arms; C. F. (Bud) Vincent, Byron-Jackson, deputy sergeant-at-arms; and E. M. Fontaine, National Tank, and C. B. McDonald, A-1 Bit and Tool, regents.

Surveys Natural Gas And Fuel Oil Market

The National Petroleum Council has been asked by Oscar L. Chapman, Interior Secretary, to make a study of the "inter-relationships" between the expanding use of natural gas and the market for fuel oils. The original suggestion to make the study was made by B. L. Majewski of Deep Rock.

A committee has been appointed to study supplies of and requirements for natural and manufactured gas, and heating and fuel oils, by geographic areas and by classes of uses.

Natural Gas Industry Grows

The expansion of natural gas has been one of the outstanding developments in the petroleum industry. According to preliminary figures for 1949, 7.8 trillion cubic feet of natural gas was produced, representing an increase in 25 years of 406 per cent.

Natural gas distribution by long distance pipe lines was expanded materially in 1949. Conversion of the "Big Inch" and "Little Inch" oil pipe lines to natural gas lines took gas from Texas to New York City. The longest natural gas line in the world, from Texas to California, was completed last year. At the present time there are about 67,750 gas wells in the U. S., with average production set at about 330,000 cu ft daily. The production of liquid fuel from natural gas has increased since 1939 by 200 per cent.

API Keeps Headquarters In New York City

The American Petroleum Institute has decided to keep its headquarters in New York City and its division and branch offices, with one exception, in their present city locations. The executive committee of the board of directors took this action in approving the report of a special reviewing committee that had been requested to consider the advisability of consolidating all of the API offices in one central location, and possibly move the headquarters to Washington.

The lone exception affected is the branch office of the department of safety currently situated in Washington. This unit, headed by Frank Wilson, will be transferred to the main headquarters in New York.

The division and branch offices that will remain in their present city locations are: Marketing and transportation divisions, Washington; production division, Dallas, Texas, and a statistical branch, Los Angeles, California.

Purchase Oil Firms

The Fin-Ker Oil and Gas Production Company has been acquired by Kearney Gas Production and Deerfield Gas Production Company. Fin-Ker owns approximately 42,000 developed acres and 8000 undeveloped acres of gas leases in the Hugoton Field, Kansas.

Continental Forms Training Division

Creation of a training division within the industrial relations department of Continental Oil Company and the appointment of Fletcher B. Emerson as director, was announced recently by L. F. McCollum, president. Fitting into Continental's general movement of expansion and management decentralization, the new division will coordinate and broaden the training activities of the company, McCollum said.

Emerson joined Continental as a roustabout in the New Mexico fields in 1939, and was named special assistant to McCollum in 1948.

Liquidates Salt Dome

A plan for the liquidation of The Salt Dome Oil Corporation has been developed by the board of directors and the company expects within the next few weeks to call a special meeting of stockholders to consider the plan. The plan contemplates, among other things, the distribution to Salt Dome stockholders, on a share for share basis, of certificates of beneficial interest in an overriding royalty equal to one-half of the net profits realized from operations of the company's interests in Cedar Point Field in Texas.

All other properties of Salt Dome, excepting current assets, would be sold separately and the proceeds would be distributed to stockholders.

Dallas Nomads Name Changed

Name of the Dallas Chapter of Nomads has been changed officially to read Dallas-Fort Worth Chapter of Nomads, according to a release received from the new president, A. J. Olson. Meetings will continue to be held on the first Monday of the month with the majority of the get-togethers in Dallas and the remainder in Fort Worth. Definite meeting places will be assigned at a later date.

At the January meeting of the Dallas-Fort Worth Chapter of Nomads officers were elected for 1950: A. J. Olson, president; K. W. Davis, vice president; C. J. Berlin, secretary; E. F. Shiels, assistant secretary; E. J. Whetzle, treasurer; R. E. Todd, assistant treasurer; J. E. Everroad, sergeant-at-arms, and J. M. Bridges, assistant sergeant-at-arms.

The following committee members were also appointed at the January meeting: J. E. Everroad, entertainment chairman; J. M. Bridges, co-chairman; J. E. Jonsson, membership committee chairman; K. Marshall Fagin, visitors committee.

Due to the large area encompassed by the Dallas-Fort Worth Chapter, Nomad representatives are appointed at strategic points and they act as general chairmen in their areas, assisting in membership and attendance at the meetings. Representatives for 1950 are: Wichita Falls area, Lewis Foster; Shreveport area, Park Myers, and Weatherford area, Jess Hall, Jr.

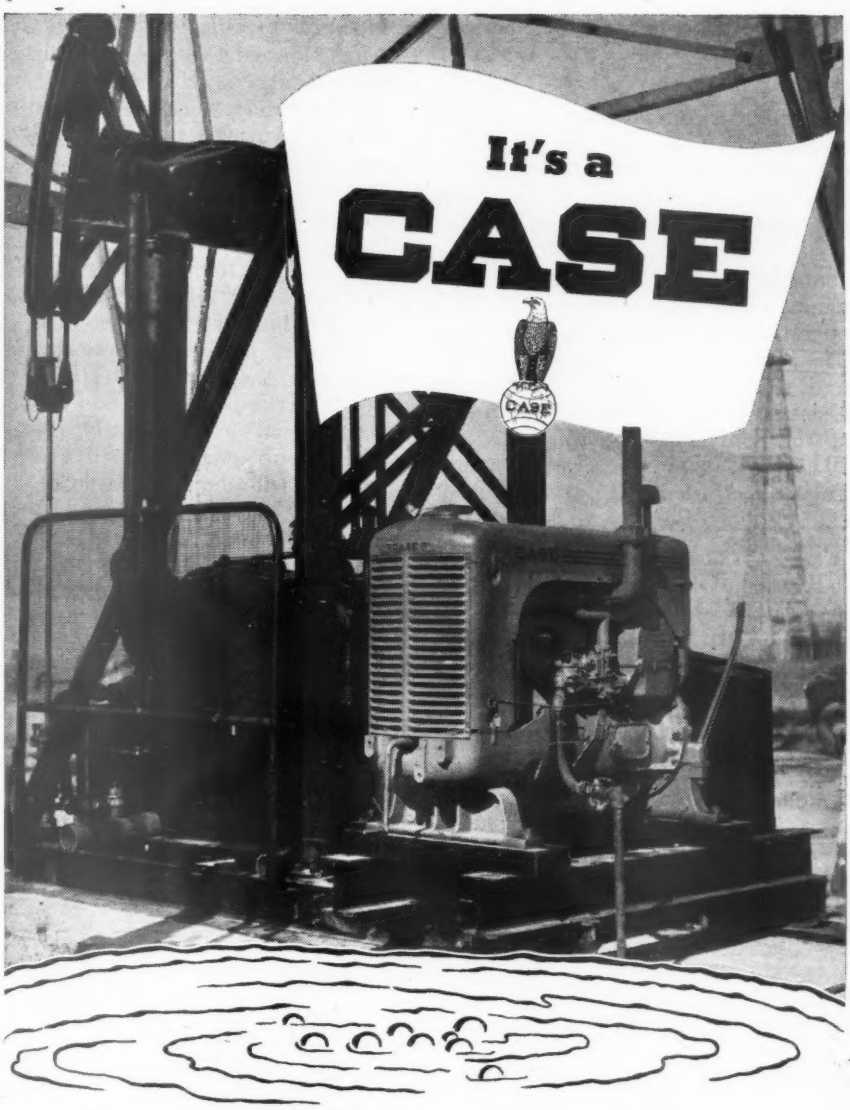
In addition to the regular committees the following committee chairmen were appointed: H. C. Otis, auditing; S. W. Webster, official photographer, and E. J. Whetzle, publicity. Regents for 1950 are Brad Mills and J. C. Baseheart.

U. S. Cuts Venezuelan Imports

The United States lowered its crude imports from Venezuela in November, breaking the upward trend in imports for the first time since the second quarter of 1948. Total imports of oil averaged 726,000 bbl daily in November comparing with 779,000 bbl daily in October, the Department of Commerce has reported. During the first quarter of 1949 the average was 599,000 bbl daily, increasing to 607,000 bbl for the second period and 620,000 for the third quarter.

WANTED

Engineer with experience in core analysis to supervise routine laboratory and research work and interpret routine results. Advanced degree preferred. Salary open. State experience, education and salary expected. Continental Oil Company, Personnel Division, Ponca City, Oklahoma.



Steady Pumping from Mile Deep Wells

● Here's typical performance for a Case "LAE" Oilfield engine—pumping a 5500-foot well with a 1¼-inch pump, twenty-four hours a day, seven days a week. The daily yield is 125 barrels.

Even on such continuous service, Case engines need no pampering. Whether you select this 61 H.P. size, the 42 H.P. "DE," the 28½ H.P. "SE," or the 24 H.P. "VAE," every Case engine is built to stay on the job. Heavy-duty design and conservative ratings at relatively low crankshaft speeds assure full power, month after month.

Equally important, Case design provides full torque or pull at reduced speeds. You can slow down the engine to reduce pump speed, saving fuel, and eliminating pulley changes. See for yourself how these engines fit your needs. J. I. Case Co., Racine, Wis.

SEE YOUR NEAREST CASE OILFIELD ENGINE DEALER

PERSONALS

James H. McCutchan was elected treasurer of the Creole Petroleum Corporation to succeed J. P. O'Brien, who has retired from the company after 20 years of service. McCutchan went to Venezuela in 1937 as an accountant for Creole. In 1946 he was named chief accountant and in 1948 operations manager of the marketing department. From December, 1948, until his recent promotion he was assistant treasurer. He was educated at the University of Missouri, the Oklahoma School of Accountancy in Tulsa, and attended Harvard Graduate School of Business Administration in 1946.

Robert E. Donovan, manager of the safety division, Standard Oil Company of California, is the new president of the veterans of safety, and **Elmo E. Chappell,** safety director of General Motors' Chevrolet plants in Oakland, is secretary-treasurer. Both men were elected recently at the group's annual meeting in Chicago. The organization is an international association of professional safety engineers who have devoted at least 15 years to leadership in their field.

H. J. Struth, well known petroleum economist, has resigned his post as assistant director of information for the American Petroleum Institute, and is returning to Dallas, his former home. Struth will open his own office in Dallas as a petroleum consultant and economic adviser to various oil and gas organizations. He will specialize in the preparation of factual surveys of all branches of the oil and gas industry in the Southwest.

Prior to joining the American Petroleum Institute in New York, Struth was editor of "The Petroleum Data Book" and formerly held the position of economist and executive assistant with the Texas Mid-Continent Oil and Gas Association at Dallas.

Struth is an active member of the Petroleum Division, AIME, has served as secretary of the Economics Advisory Committee to the Interstate Oil Compact Commission, and as a member of the Statistical Advisory Committee of the API.

Paul G. Blazer, chairman of the board of the Ashland Oil and Refining Company, has been appointed a member of the safety committee of the board of directors of the American Petroleum Institute, it is announced by B. H. Markham, acting president of the Institute.

A. L. Snow was named manager of the California Research Corporation's patent department and elected a vice president of this subsidiary of the Standard Oil Company of California. He succeeds **J. N. Adams,** a vice president of the research company, who retired after more than 31 years of service. Snow joined Standard as a patent attorney in 1935 after five years spent with the United States Patent Office in Washington. At the end of 1944 he was made senior patent attorney in charge of chemicals, and last year became assistant manager of the patent department.

Two other patent department personnel changes include the appointment of **O. S. Loud** and **H. B. Wands, Jr.,** as assistant managers.

Twelve new appointments augmenting the technical staffs of Southwest Research Institute of Houston and San Antonio and its affiliated organization, the Institute of Inventive Research, were recently announced.

Appointments to the staff are **Donald Abbott** of New York City, who has conducted research in atomic energy, building construction and mining, and **John R. Barton** of Atlanta, Georgia, whose special fields are mechanics, thermodynamics, electronics, and instrumentation.

Officers for 1950 and guest speaker at 10th anniversary reception and dinner Tulsa Chapter Nomads, January 18 in the Tulsa Club. Seated: H. M. Cosgrove, executive secretary, National Board of Regents; Amos Roberts, Baroid division, National Lead Company, vice president; Henry H. Hewetson, chairman of the board, Imperial Oil Ltd., New York, Canadian subsidiary, Standard Oil of New Jersey, guest speaker; G. W. Davidson, Jr., W. C. Norris Manufacturing, Inc., chapter president. Back row: R. E. Kirberger, Franks Manufacturing Company, treasurer; H. M. Cooley, Bethlehem Steel Corporation, regent; Arch Campbell, diesel oilfield division, General Motors, deputy sergeant at arms; G. F. Coons, National Tube, assistant secretary; J. S. George, Hughes Tool, sergeant at arms; K. O. Hoevel, National Supply, who presided at the dinner, regent. Not in picture, Opie Dimmick, Century Geophysical Company, secretary; Gilbert Swift, Well Surveys, Inc., assistant treasurer. Approximately 300 persons, consisting of Nomads and oil company executives from the greater Mid-Continent area attended this function. The new officers were introduced at brief formalities preceding the feature address.

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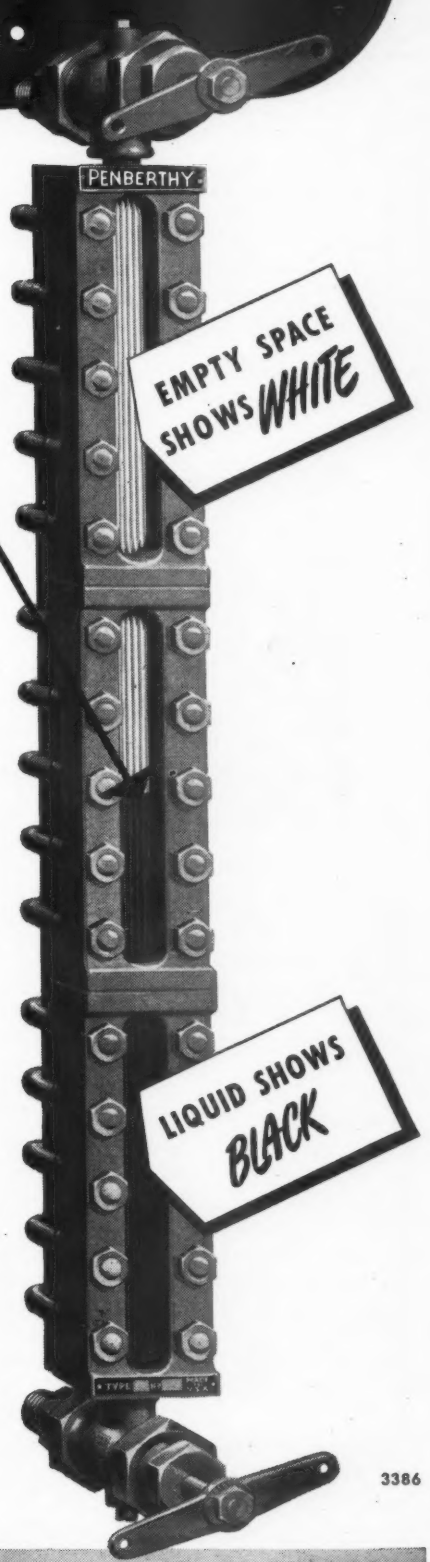
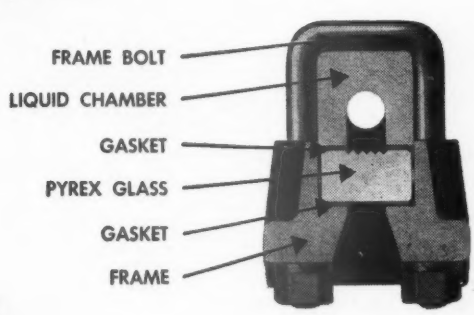
PENBERTHY Reflex GAGES



The refraction of light (an unvarying law of nature) makes the reading of Penberthy Reflex Gages unmistakable. Due to this refraction principle, the empty space always shows white—the space occupied by liquid always shows black. The dividing line between liquid and empty space is sharp and unmistakable, there can be no error in reading. It is easily read as far as you can distinguish between black and white.

Penberthy Drop Forged Steel Reflex Gages are available in whatever lengths required and for various liquids. They are also fabricated to customer's specifications from special alloys to meet unusual corrosive and temperature conditions. There is a Penberthy Gage of superior quality for every liquid level gage requirement.



3386

PENBERTHY PRODUCTS

PENBERTHY INJECTOR COMPANY

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Established 1886 • **Canadian Plant, Windsor, Ontario**

▸ The resignation of **Alvin Untermyer** as a director of Sinclair Oil Corporation was presented at a meeting of the board of directors of that company. Untermyer had been associated with the Sinclair company nearly 20 years.

To fill the vacancy caused by Untermyer's resignation, the board elected **P. W. Thirtle,** who has served as general auditor and comptroller of the parent Sinclair company since its formation in 1916. Thirtle has for more than 30 years been an important factor in determining policies of the company in many fields of its activities. He has been a director and vice president not only of the parent company but of many of its subsidiaries.

▸ **H. B. Hurley,** assistant regional general manager of Continental Oil Company, Fort Worth, Texas, has re-

H. B. Hurley

signed to become vice president of Republic Natural Gas Company, Dallas. He has spent more than 30 years in the oil and gas business, and has been with the Continental Oil Company for 23 years. He joined the production department of the company at Ponca City, Oklahoma, in 1926, and through successive promotions attained his present position, after having served in the production department in supervisory positions in Oklahoma, Texas, and New Mexico. He has been in charge of Continental's production operations in the Fort Worth region since 1938, and last year was named assistant regional general manager of the Fort Worth and Houston regions.

▸ **Byron B. Boatright,** petroleum and natural gas engineer has opened consulting offices in Austin, Texas. His office will be in the Capital National Bank Building. He was vice president and chief engineer for Republic Natural Gas Company for about two years in Dallas, and for the last year and a half has been vice president and general superintendent of the Conroe Drilling Company.

▸ **Charles R. Wheeler** of Glendale, California, has been appointed Pacific Coast field service representative for

Charles R. Wheeler

the Pennsylvania Grade Crude Oil Association. He succeeds **E. H. Fallin** of Los Angeles who has resigned to accept a position with the National Petroleum Association in Washington, D. C. Fallin joined the Penn Grade organization in 1943.

Wheeler took over the assignment January 1. He has been associated for several years with the Veterans Administration, with headquarters in Los Angeles. Until moving to California in 1946 he had served as the Association's field service representative in the Midwest, with headquarters in Chicago, Illinois.

▸ **George Samuel Rice,** retired chief mining engineer of the U. S. Bureau of Mines who died at Washington Sanitarium in Takoma Park, Maryland, on January 3, was a pioneer in applying scientific knowledge to increase safety and improve efficiency in the mining of coal, James Boyd, Director of the Bureau, said.

His passing, said Boyd, is a distinct loss to the Nation and is deeply regretted by the Bureau of Mines staff, as well as all others who had the privilege of knowing him and working with him.

▸ **George W. Auxier,** K.C., barrister from Edmonton, has been appointed executive vice president and general manager of the Western Canada Petroleum Association, with headquarters at Calgary. A graduate of the University of Alberta, Auxier was formerly with the Hawe, Auxier, Bryan, and Foote firm.

▸ **Eugene Holman,** president of Standard Oil of New Jersey, will be the principal speaker at an annual banquet of the Chamber of Commerce in San Angelo, Texas, on March 21. In addition to members of the Chamber of Commerce, Holman will address oil men from surrounding cities in the West Texas field.

▸ **H. S. Gibson,** C.B.E., M.A., M.I. Mech.E., F.Inst. Pet., has been appointed managing director of the Iraq Petroleum Company, Limited, and Associated Companies on the retirement of **J. Skliros,** O.B.E.

Gibson attended Emmanual College, Cambridge, and joined the Anglo-Persian Oil Company, Limited, as production engineer, being promoted to production superintendent in 1928, and to production manager two years later. He was put in charge of the Anglo-Iranian Oil Company's research station at Kirklington Hall in Nottinghamshire last year.

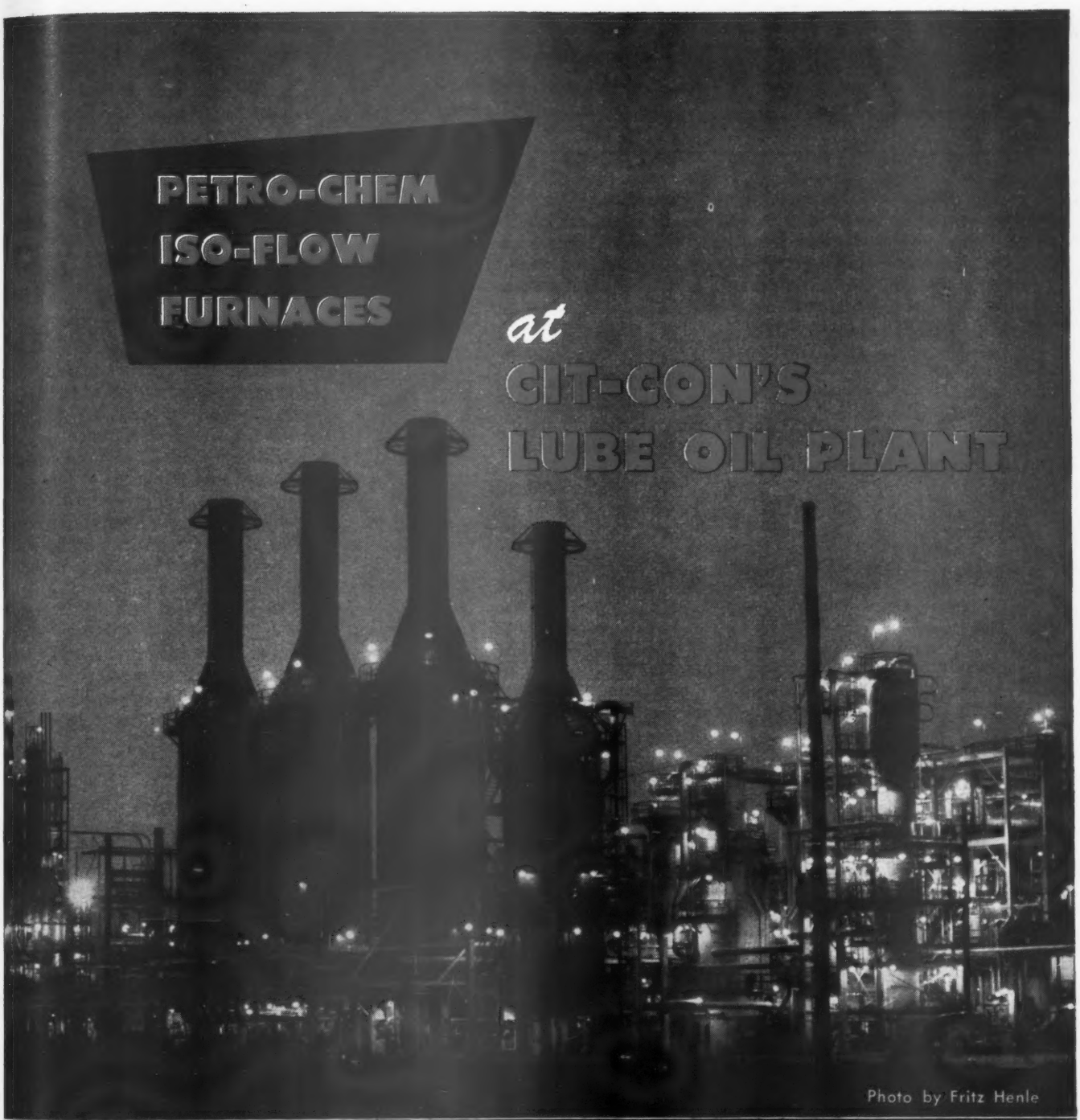
Skliros retired from Iraq Petroleum after 25 years with the company, 15 as managing director. He joined the Anglo-Persian Oil Company in 1923, going to the London office the following year. He became general manager in 1934.

▸ **Charles F. Park, Jr.,** internationally recognized expert on ore deposits, was named as the new dean of the Stanford School of Mineral Sciences. He succeeds Dean A. I. Levorsen, who will remain on the Stanford faculty as professor of geology but who wishes to be freed of administrative work so that he can devote his time to teaching and research in petroleum geology.

▸ **Hal W. Stewart** has been appointed to the newly established position of assistant general counsel of the

Hal W. Stewart

Ohio Oil Company, J. C. Donnell II, president, has announced. Stewart has been an attorney in the company's legal department for the past 27 years. In his new position, he will assist in the general work of the office of A. M. Gee, general counsel. A native of Bozeman, Montana, Stewart was employed by the Ohio Oil Company at Shelby, Montana, in 1922 following his graduation from the University of Virginia School of Law. He went to Casper, Wyoming, in 1924 as assistant division attorney, and was made attorney in 1927.



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LAUGH WITH BARNEY

A young mother was discussing with an older woman the arrangement worked out with her husband about feeding the baby in the night. "Who in your family got up to feed the baby?" she asked the elderly visitor.

"Well," the other replied, "it certainly wasn't my husband. You see, young lady, we didn't have bottles in those days."

' ' '

You never can tell how a girl's going to turn out until her folks turn in.

' ' '

A stenographer is a girl you teach to spell while she is looking for a husband.

' ' '

Irvin Cobb said: "If it ever becomes my misfortune to go insane, I want to go live in Washington where I will not be noticed."

' ' '

Irate wife: I want an explanation, and I want the truth.

Hubby: Well, make up your mind. You can't have both.

' ' '

At six o'clock she laid out his dinner suit, at seven she laid out his evening clothes, at eleven she laid out his pajamas, and at three o'clock he came home and she laid him out.

Missionary: Do you know anything about religion, Chief?

Cannibal: Well, we got a little taste of it when the last missionary was here.

' ' '

A certain rather seedy little hotel down in Alabama has adopted a simple but effective means of forestalling complaints from its disgusted patrons. Prominently displayed near the clerk's desk is a large sign reading:

"This ain't the Waldorf-Astoria; if it was it wouldn't be here."

"You ain't J. P. Morgan; if you was you wouldn't be here."

"We know this hotel is on the bum —well, how about yourself?"

' ' '

A spinster was shocked at the language used by workmen repairing a telephone line near her home, so she wrote the telephone company.

The Foreman was requested immediately to make a report of what happened. The report read as follows:

"Me and Spike was on this job. I was up the pole and accidentally let the hot lead fall on Spike—right down his neck. Then Spike looked up at me and said: "Really, Harry, you must be more careful."

Aneurin Bevan, British Minister of Health, declared in an interview in New York that socialized medicine is inevitable and that the United States must eventually come around to it.

That, Mr. Bevan, is impossible, even if we thought socialized medicine were desirable, and we don't.

For, as long as we are paying for Britain's socialized medicine, we can't afford it for ourselves; and, if we stop paying for theirs, they can't afford it, either.—*Charlotte Observer.*

' ' '

A group of men were in the club just before dinner. The talk, for no good reason, turned to married life.

"Well," said one fellow, "the real comfort in life arrives when you've settled down with one woman you love. You can argue all you want, but it's my opinion that, once they've settled down, most men remain faithful."

Most of the men present agreed with him, but an older man in the group shook his head.

"I don't agree at all," he asserted. "And if you fellows are honest, you'll know I'm right. I'll bet any and all of you men a new hat that there isn't one of you who hasn't strayed from the straight and narrow since he's been married."

"I'll take that bet," cried one, swiftly.

"How long have you been married?" asked the cynic.

"Since last Saturday," was the reply.

The crowd, roared of course—and one of the listeners was so amused that he could hardly wait to get home to tell his wife about it.

At the end of the story he laughed and laughed. But his laughter died as he noticed a strange expression on his wife's face.

"What's the matter?" he asked. "Don't you think the story's funny?"

"Very funny," she replied, quietly. "But where is *your* new hat?"

' ' '

Sandy and wife paused thoughtfully in front of the restaurant bearing the sign: "Dinner here from 12 to 3—50 cents."

"Coom, lass," Sandy said, nodding approval, "three hours' eatin' for fifty cents is verra reasonable."

' ' '

A wise man is he who has sense enough to cast his lot with the woman who has at least money enough to build a house on it.

' ' '

On clothes she spends her legal tender;
Because this truth she's found—
A dress can make a girl look slender,
And a hundred men look 'round.

OIL AND GAS TRADE NEWS

Williams to Direct Core Lab Expansion

Core Laboratories, Inc., Dallas, Texas, announces a broadening of its reservoir engineering department to offer more comprehensive service to oil producers, production engineering departments of major companies, investment organizations, and private petroleum engineering firms engaged in field development work.

Nelson W. Williams, recently appointed chief reservoir engineer, has been transferred from Core Lab's Bakersfield, California, office where he served for the past seven years as district engineer of the West Coast area, to the firm's main offices in Dallas.

International-Cementers Stock Patterson-Ballagh Line

International Cementers, Inc., are now stocking Patterson-Ballagh oil field specialties in the Rocky Mountain area, according to Bob Harcus, executive vice president and general manager.

P-B wipers, bumpers, wire line guides and stabilizers, production products, etc.—the entire P-B line—will be available through each of ICI's service points in the Rocky Mountain area.

Renauld Named Distributors

Graver Water Conditioning Company, manufacturers of equipment for all water conditioning processes, announces the appointment of Fred S. Renauld and Company as Los Angeles representatives.

Renauld and Company is headed by Fred S. Renauld, who is a registered professional engineer in the state of California and has been identified with the manufacture of water treating apparatus for many years.

Ampco Names Distributors

Ampco Metal, Inc., Milwaukee, Wisconsin, has announced the appointment of the following concerns as exclusive stocking distributors, in their respective areas, for the complete line of Ampco centrifugal pumps. Distributors include: Walter H. Eagen Company, Inc., Philadelphia, Pennsylvania; Kerr Machinery Company, Detroit, Michigan; Pump Engineering, Los Angeles; Jackson Engineering Company, Indianapolis, Indiana; Diehl Pump and Supply, Louisville, Kentucky; Ramsay Pump and Supply, Pittsburgh; Westco Pump Sales, San Francisco; Truscott Company, Portland, Oregon; Southern Engine and Pump, Houston (branch sales offices in Dallas, San Antonio, Kilgore, and Edinburg, Texas); McLellan A-C Supply, New Orleans, Louisiana; J. J. Heinrikson and Son, Kansas City, Missouri; Connecticut Pump, North Haven; Chase Pump and Equipment, Providence, and Ryan Hydraulic Specialties, Phoenix, Arizona.

U. S .Rubber Buys Chemical Division

United States Rubber Company has purchased the chemicals division of The Glenn L. Martin Company, according to a joint announcement made by the two companies. The rubber company will acquire all assets of the division, including the Marvinol vinyl resin plant at Painesville, Ohio, laboratory equipment in Baltimore, patents and the trade name Marvinol.

Blaw-Knox Company Forms Chemicals, Fuels Division

Blaw-Knox Company has announced the formation of a chemicals and fuels synthesis department. The new activity will deal with the conversion of fuels into chemicals. This work will be based initially on the Fischer-Tropsch synthetic fuels process and on related processes for making synthesis gas.

Standard Steel Buys Hersey

Standard Steel Corporation of Los Angeles, California, one of the largest fabricators of heavy steel plate in the west, announced the purchase of the drying machinery division of Hersey Manufacturing Company of Boston, Massachusetts. Standard Steel has for many years manufactured drying and dehydration equipment for chemicals, fertilizers, and by-products.

Ampro Offers Reprints

"Copper-Base Die Alloys" is the subject of an article written by J. F. Klement, chief metallurgist of Ampco Metal, Inc., developers of these alloys. Reprints of this article, which describes the advantages, how best results are secured, producing, preparing, and machining of such dies can be obtained from Ampco Metal, Inc., Milwaukee 15, Wisconsin.

Bridgeport Brass Opens New Dallas Sales Office

The Bridgeport Brass Company has opened a new district sales office in the Reserve Life Building in Dallas, Texas, to handle the sale of all Bridgeport mill products, plumbing brass goods, copper water tube and pipe. The new office will be under the direction of the Dallas district manager, B. M. Neilson, who has had considerable experience in the metals and refining fields in the Southwest.

Republic Supply Makes Personnel, Other Changes

Harry B. Catlow, president of Republic Supply Company, has announced several personnel-organizational changes. Effective January 2, 1950, Republic's District No. 2, which formerly included the Texas and Louisiana Gulf Coast area, was split into three parts. H. C. Kinney, manager of District No. 2, moved his headquarters from Houston to 1716 Alamo National Building in San Antonio. This district will now include the following stores: Corpus Christi, Alice, Hebbronville, McAllen, Pleasanton, Falfurrias, and Victoria.

Under the new arrangement, the city of Houston and surrounding trade territory will become the Houston district sales office and will be under the management of Ralph B. Harp with offices in the National Standard Building. Republic's New Iberia and Lake Charles, Louisiana, stores which were formerly a part of District No. 2 will be under the supervision of W. M. Haynes.

At the same time, Catlow announced the creation of the Repsco seal division of the refinery and industrial sales department, which will be under the management of Frank Sparks.

Howard Supply Opens Warehouse

Announcement of the completion of Howard Supply Company's new steel warehouse one block south of their present warehouse at Oakland, California, has been made by D. S. Bradbury, vice president in charge of operations for Northern California.

Construction of the new warehouse, according to Bradbury, was necessary in order to have sufficient room to stock the new lines of refinery and industrial supplies that the company has added.

BROWN FINTUBE'S *advantages*

EXTREME FLEXIBILITY
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QUICK DELIVERY
Only a Few Hours in Emergency

INCREASED CORROSION ALLOWANCE
Longer Tube Life

continuous operation

Brown Fintube Sectional Exchangers Eliminate Shut-downs for Cleaning Pay Users Extra Dividends

● By simply manifolding an extra parallel stream into the bank, one stream after another can be taken off-line and cleaned, while the exchanger operates at full capacity.

This avoids the necessity of carrying a 100% standby unit to insure continuous operation. It permits the sections to be cleaned as frequently as the duty requires, without effecting other parts of the plant, and assures *clean surfaces* and *efficient* operation, year after year, without shut-down.

For the utmost in efficiency and economy — use Brown's proven, welded fintube heat exchangers throughout your plant. Estimates and quotations furnished promptly. *Write for Bulletin No. 481.*

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ELYRIA, OHIO

SECTIONAL HAIRPIN HEAT EXCHANGERS

Buys Beaver Tool Company

John R. Riley and G. C. "Red" Ross, of Big Four Machine and Supply Company, have announced the purchase of the Beaver Tool and Machine Company, Maysville, Oklahoma, from Fred Wallace and associates. This shop, while retaining the name of Beaver Tool, will serve the "Golden Trend" area in Western Oklahoma and North Texas.

The other two Big Four plants are in Clay City, Illinois, and Pawhuska, Oklahoma.

Notes Increased Use Of Engine Snubbers

Increased use of Burgess-Manning snubbers in the oil and gas industry to reduce noise, vibration, and to eliminate the danger of sparks, has been reported by R. L. Leadbetter, vice president and general manager of the Burgess-Manning Company, of Libertyville, Illinois. Pointing to several recent installations of such equipment in refineries and pipe lines, Leadbetter observed that the oil and gas industry is becoming increasingly aware of the cost and danger of uncontrolled engine exhaust and is installating control equipment throughout the industry.

Detrick Company Buys American Arch Firm

The industrial department of the American Arch Company, Inc., New York, has been purchased by the M. H. Detrick Company American Arch division with offices in the Oliver Building, Pittsburgh, Pennsylvania.

Former American Arch Company Industrial Department executive personnel have been retained.

Develops Scale Remover

Doctor Boiler, Inc., Dallas, Texas, makers of "Doctor Boiler," a scientific preparation for the prevention and removal of boiler scale, claim its action is different from the ordinary "boiler compound."

The term "Colloidizing" was coined from the word "Colloid" to describe the unusual process of scale removal employed by "Doctor Boiler." They explain that "Doctor Boiler" provides a microscopic film, that covers the inside of the boiler and seals off the moisture and chemical action of the water from the scale itself. Thus the scale is dried out and the expansion and contraction of the metal, together with the peptizing action developed by the solution, causes the scale to leave the side walls of the boiler and the tubes and drop to the bottom of the boiler to be flushed away.

Forms Canadian Company

Maloney-Crawford Tank and Manufacturing Company of Tulsa, Oklahoma, has formed Maloney-Crawford of Canada, Ltd., to handle its Canadian business, according to S. P. Wallace, president.

G. M. Cheatham

George M. Cheatham, Jr., who has been representing Maloney-Crawford in Canada, has been placed in charge with headquarters in Edmonton.

Williamson Names Dealers

Keyes Tank Companies of Salt Lake City, Utah, and Casper, Wyoming, and Harold E. Davis of Los Angeles have been appointed distributors by T. D. Williamson, Inc., pipe line equipment manufacturers of Tulsa, Oklahoma.

Davis, formerly associated with the Richfield Oil Corporation, will have as his territory the state of California, and will represent other manufacturers of equipment required by the pipe line industry.

Moves Offices

American Steel and Wire Company has announced removal of its offices to Room 902, First National Bank Building, 1407 Main Street, Dallas, Texas. Offices were formerly in the Praetorian Building in Dallas.

Stainless Steels Play Large Role in Industry

Approximately two years of service in diversified types of applications is proving the industrial importance of the extra-low carbon stainless steels. Lower over-all costs compared with stabilized grades and greater corrosion resistance adjacent to welds have been obtained through the use of these improved stainless steels.

First offered to industry as a standard grade by Armco Steel Corporation in late 1947, the ELC (extra-low carbon) stainless steels have been widely used, especially in the chemical, pulp and paper, petroleum, and textile industries. The ELC designation indicates a maximum carbon content of 0.03 per cent as compared to about 0.10 per cent for regular grades.

Merger Announced

The merger of American Air Filter Company, Inc., Louisville, Kentucky, manufacturer of air filters and dust collectors, and Herman Nelson Corporation, Moline, Illinois, became effective as of January 6. The Nelson Corporation henceforth will be operated as the Herman Nelson Division of American Air Filter Company, Inc., and will continue to maintain its headquarters and facilities in Moline. The merger company's principal offices and headquarters will be in Louisville.

W. G. Frank, executive vice president and Richard H. Nelson have been elected directors of the combined firm. Richard H. Nelson and Robert W. Nelson have been elected vice presidents of the enlarged firm and E. G. Mason, of the Herman Nelson Division has been elected assistant secretary and assistant treasurer.

Tube Turns Opens Plant

Tube Turns of Canada, Ltd., which was granted its Dominion charter on December 2, is establishing a plant in Chatham, Ontario. The company will manufacture Tube-Turn welding fittings.

Petro-Tech Acquires Venezuelan Business

Petro-Tech Service Company, Lane-Wells affiliate in Venezuela, has acquired all property and license rights of Seismograph Service Corporation of Delaware in its well logging and shape-charge perforating business in Venezuela. Announcement of the purchase was made January 6 by Rodney S. Durkee, president of both Lane-Wells and Petro-Tech. Operations in Venezuela are under the direction of Russell W. Keener and Keith H. Miner, vice presidents of Petro-Tech.

Pipe Sample Offered

Hill, Hubbell and Company is currently offering a free 4-in. pipe sample that shows both "Before" and "After" the pipe has been processed by their "Roto-Grit-Blast" machine.

The manufacture of these unique desk-sized pipe samples, is the result of requests from corrosion engineers and other experts in allied fields, who wanted to see the effects of the Hill, Hubbell process at first hand. For comparison, one end of the pipe is left uncleaned — the other has traveled through a powerful blast of steel grits that not only cleans but etches the pipe to assure permanent bond of primers and coatings.

This sample may be obtained free, by writing: Hill, Hubbell and Company, 3091 Mayfield Road, Cleveland 18, Ohio.

By Price — or Performance?

WHEN you buy piston rings, you are actually buying power. This being the case, you want to be sure of getting rings which will provide maximum power at minimum cost.

Since there is so little difference in the price, what standard should you use as a basis for selecting the right piston rings for your engine? The answer is plain enough — performance!

And when it comes to low-cost, efficient performance, Cook Rings excel. Proof of this comes from the records of hundreds of operating engineers who report definite savings in fuel and maintenance costs by using Cook Rings.

The answer lies in the fact that Cook Rings combine high precision construction with scientifically correct ring material, and they are job engineered for your specific engine and operating conditions.

It will pay you to investigate the savings in lowered power costs and stepped-up performance you'll get with Cook Rings. Call the nearest Cook office and ask for a job-engineered survey of your piston ring requirements.

C. Lee Cook Mfg. Co., Louisville, Kentucky. Branch offices in Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, New Orleans, New York, San Francisco and Tulsa.

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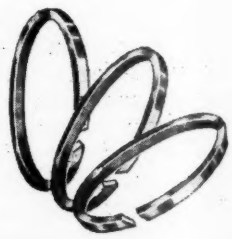
PISTON RINGS



. . SEALING PRESSURES SINCE 1888 . . .

TRADE PERSONALS

▸ **Jack W. Askins** has been appointed foreign sales representative of Sterling Packing and Gasket Company, Houston, Texas, and Drilling Equipment Manufacturing Company, Oklahoma City, Oklahoma.

J. W. Askins

Askins' headquarters will be at 233 Broadway, New York, New York. A native of Texas, and a member of the New York Chapter of Nomads, Askins spent two years in South America as an executive for the American Rolling Mill Company, AIC division. For the past 14 years he has been associated with the export phase of oil equipment sales.

▸ **Donald A. Fruland** was elected assistant treasurer of the Thermoid Company in Wilmington, Delaware recently. This election followed closely the appointment of Fruland as director of purchases by Thermoid. Fruland first joined the purchasing staff of Thermoid Company in 1939, having previously been with the Gulf Oil Corporation.

Emil J. Houser was officially appointed assistant purchasing agent for Thermoid Company.

▸ **Al Seaman** was recently added to the sales staff for Black Magic oil base drilling fluid and mud conditioning products for Oil Base, Inc., Compton, California.

Seaman was formerly with Baroid in the well logging division, with Macco in California and Wyoming, and served in the Los Angeles basin for Oil Well Chemical Company. He will cover the San Joaquin Valley as a service engineer for Oil Base.

▸ **Fred Parks** has been named division sales manager of Bethlehem Supply Company for the Houston-Gulf Coast area. This area includes all of Bethlehem's operations from New Orleans, Louisiana, to McAllen, Texas. In addition, Parks will correlate and coordinate the sales activities of field personnel situated at the various stores throughout this area.

J. V. Spalding was appointed division machinery manager, assisting Parks in the selling and furnishing of engineering specifications of drilling and production machinery. Spalding has been with Bethlehem for 11 years, 5 of which were spent in the Houston and Gulf Coast area.

▸ **Clifford F. Hood,** president of American Steel and Wire Company, Cleveland, Ohio, United States Steel subsidiary, has been elected president of Carnegie-Illinois Steel Corporation, Pittsburgh, Pennsylvania, another U. S. Steel subsidiary. Hood succeeds **Charles R. Cox,** who has resigned as president of Carnegie-Illinois Steel to become president of Kennecott Copper Corporation, New York.

Hood rose from an operating clerk in one of the plants of American Steel and Wire to the presidency of the largest steel-producing subsidiary of United States Steel. In 1917, he became an operating clerk in the Worcester, Massachusetts, plant of American Steel and Wire, and in 1938 he became president of the company.

Cox became president of Carnegie-Illinois Steel in 1946. His appointment as head of Kennecott Copper fills the vacancy left by **E. T. Stannard,** who was killed in a plane crash in Canada.

Harvey B. Jordan, vice president in charge of operations of American Steel and Wire since 1939, has been elected president. Jordan succeeds Hood. He has been with American Steel and Wire for 35 years. He worked his way up through the ranks to the positions of first general foreman and then assistant superintendent, and became superintendent of the plant in 1929. Ten years later he was appointed vice president in charge of operations.

James E. Lose, vice president in charge of operations, Carnegie-Illinois Steel has been elected executive vice president. Lose, who began his business career with Carnegie Steel Company, one of the predecessors of Carnegie-Illinois, in 1910, becomes the first official to occupy this newly-created position with the company.

▸ The appointment of **A. F. Woods** as district sales representative is announced by Marlow Pumps, Ridgewood, New Jersey.

Woods was formerly district sales manager for the Yale and Towne Manufacturing Company, pump division, and prior to that an engineering officer in the Army Air Forces.

▸ **R. E. Barnett** has been promoted assistant sales manager of Marsh Instrument Company, sales affiliate of Jas. P. Marsh Corporation.

Barnett has been with the Marsh organization for the past 9 years in a sales capacity with headquarters at the company's home office in Skokie, Illinois.

▸ **Arthur Miller, Jr.** has been appointed assistant sales manager for W. C. Norris, Manufacturer, Inc.,

Arthur Miller, Jr.

Tulsa, Oklahoma. Miller joined Norris in 1936, and worked in the shop and warehouse. From 1938 until 1942, he was at St. Elmo and Mt. Carmel, Illinois as warehouseman, store manager, and field salesman. Miller served in the Air Corps until October, 1945, at which time he rejoined Norris as a field man covering East Texas, Southern Arkansas, Louisiana, and Mississippi.

▸ Appointment of **Herbert G. Kieswetter** as assistant general manager of the mechanical goods division, United States Rubber Company, was announced recently.

Kieswetter was formerly vice president and assistant general manager of United States Rubber Export Company, Limited. His new appointment with the parent company was effective January 1. In 1942 he was appointed assistant general manager, and in 1945 was named vice president and assistant general manager of the export company.

▸ **Ray Morris** was recently appointed to head sale of Red Devil products in the Los Angeles basin by Oil Well Manufacturing Corporation. Morris is well known throughout Southern California. He was with Patterson-Ballagh for many years, a field supervisor for Baroid, and more recently operated his own manufacturers' representative agency in Los Angeles.

As a side line, he has coached Junior American Legion baseball teams. His son, Ray, Jr., has been a mainstay on these teams, and has made an outstanding record as an infielder on his Junior College team.

▸ **H. P. Fogle** has joined Standard Pipeprotection, Inc., St. Louis, Missouri, as manager of sales for the Southwest area with headquarters at Houston, Texas.

Before becoming district manager for Standard Pipeprotection, Inc., Fogle was assistant division manager for Oil Well Supply at Houston, Texas.

▸ **Jim Streger,** for many years district manager for International Cementers, Inc., has joined Oil Well Manufacturing Corporation, Los Angeles, California, in a sales capacity. After a two-weeks training period at the plant, he will move to Ventura to serve the area from Newhall to Santa Maria, under the supervision of **Best Dawson,** sales manager for Red Devil slush pump products.

▸ Spencer Chemical Company has announced the promotion of **William Schopflin** to the position of assistant sales manager, industrial chemical sales.

Schopflin, who has been with the company since 1946, was formerly sales supervisor, industrial chemical sales. He will continue to make his headquarters in Spencer's executive and sales offices in Kansas City.

▸ **James A. Ford,** sales manager of Jerguson Gage and Valve Company, Somerville, Massachusetts, was elected vice president and director at a recent meeting of the board of directors. Ford came to the company as sales manager in 1945 after long experience in the field of instrumentation and controls.

▸ **William VanVleet** was appointed Eastern division manager of The National Supply Company, comprising 32 of the company's supply stores serving the oil, gas, and water well industries. VanVleet has been associated with National Supply since 1913, working at the company's stores at Findlay, Ohio, Tilbury, Ontario, and Butler, Pennsylvania.

He was appointed store manager in Bolivar, New York in 1929, and afterwards became assistant manager of the Eastern division of the company. He succeeds **Ernest N. Smith,** who retired January 1.

▸ **John S. (Jack) Talbot,** development engineer for Dowell Incorporated in Alice, Texas, has been promoted to district sales engineer and transferred to the Houston area district office. **Tom J. Tighe,** service engineer at Houma, Louisiana, has been promoted to sales engineer at Victoria, Texas, and **Joe P. Moran,** Victoria sales engineer, has been transferred to Alice. A graduate of Texas A&M, Tighe joined Dowell in 1948.

▸ **John E. Eckel,** formerly vice president in charge of engineering, Oil Center Tool Company, and **Marvin**

J. E. Eckel

M. R. Jones

R. Jones, former chief engineer of the same company, have formed The Petroleum Mechanical Development Company at 3803 South Main Street in Houston, Texas.

This company has been organized to develop new oil tools and to consult on petroleum mechanical engineering. Excellent manufacturing facilities are available for the development and manufacture of new oil tools. These tools will be sold under the trade name "Petromec."

▸ **Ernest N. Smith,** Eastern division manager, The National Supply Company, has retired after 28 years with the company. Smith joined National Supply in 1921 as a salesman in the Pittsburgh office. He became manager of the Pittsburgh office in 1925. Since 1933, he has been Eastern division manager, supervising an area that includes 32 of the company's 100 oil and gas industry supply stores. Smith is a member of the API and the AGA.

▸ **Robert L. McFadin** has been named manager of the merchandising sales department of The Marley Company, Inc., and as a result, has transferred to the main offices of the company in Kansas City, Kansas. For the past year, he had been in charge of merchandising sales in the New York office, and in his new position will have charge of such sales for the entire Marley organization.

▸ **C. C. Rausch,** assistant vice president, Dearborn Chemical Company, has been appointed manager of the industrial department's NO-OX-ID rust preventive sales. Rausch, formerly associated with the railroad field primarily, will head rust preventive sales in all company markets.

J. G. Surchek, technical advisor and engineer, has been made assistant manager of all production and maintenance NO-OX-ID sales.

E. M. Welch, formerly Dearborn sales representative in Pittsburgh, has joined the Chicago office as manager of sales of water treatment and equipment. **C. S. Silsbee** has been named assistant manager in charge of all national accounts and service, both treatment and NO-OX-ID.

In addition, Dearborn has appointed **A. H. Reynolds,** formerly directing chemist of the company's laboratories, as director, product development, and will be assisted by **L. O. Gunderson** as assistant director.

Wayne L. Denman has been promoted to the position as directing chemist of Dearborn laboratories, with headquarters at the company's main factory and laboratories at 1029 W. 35th Street, Chicago.

Milton H. Hagman has taken over all responsibilities of controller, replacing **Adolph Geidel,** who retired as assistant treasurer after 40 years service with the company. **Fred W. Mayer** has been promoted to the position of auditor.

▸ **Arthur L. Larson** was recently appointed assistant to the sales manager, of Falk Corporation, Milwaukee, Wisconsin. Larson also moves up to the position of manager of the sales inquiries division.

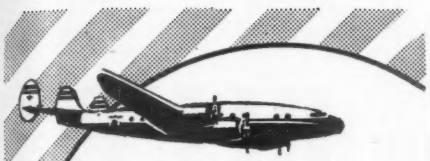
William J. Urban, former special representative in coupling sales, has been appointed manager of coupling sales. The new manager of distributor sales is **Don K. Lambert.** He was, previously, special representative in the Distributor Sales Division. **Roland E. Govan** heads sales promotion, a newly organized department at Falk. Working with him are **Eugene H. Millmann** and **A. H. Kelley.**

Three former sales trainees have been appointed to Falk district sales office staffs. **Nile E. Sweet,** special representative, distributor division, goes to Detroit for special training. **Harold G. Fleischer** transfers to the New York district office to handle inquiries and orders, and **Elliot G. Heuser** is assigned to the Wisconsin sales division headed by **L. H. Billing,** sales representative.

▸ The appointment of **Harold D. Powell** to the position of manager, tubular department, Mid-Continent Supply Company, has been announced from the Fort Worth, Texas headquarters of the company.

Associated with the oil industry for 20 years, Powell was first employed by Landreth Production Company in 1929. He subsequently was associated with the National Supply Company at Pyote, Texas, and served in the capacities of Kilgore store manager and Houston city salesman.

L. G. Moore was named sales engineer of the Oklahoma City district of Mid-Continent Supply.



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THE WORLD'S FIRST AIRLINE 1919—1950

KLM
ROYAL DUTCH AIRLINES

▸ The appointment of **Joseph G. Broz** as sales manager of the four cycle diesel engine department was announced by Nordberg Manufacturing Company, Milwaukee, Wisconsin.

Broz was vice president in charge of sales of Busch-Sulzer Diesel Engine Company of St. Louis, Missouri at the time that company was purchased by Nordberg in 1946. Until his present appointment he was surveying South American market potentialities and establishing field sales and service organizations there for Nordberg.

H. M. Cahill will assist Broz in directing the sales activities of Nordberg's four cycle diesel engine department.

▸ **George S. Ames** was named district manager of the Findlay, Ohio division of Gar Wood Industries. In accordance with the new Buckeye Pipeline Policy, Ames' duties will be to contact all pipe line contractors relative to their sales and service problems on Buckeye equipment.

Ames has had over 25 years of experience working on pipe line construction, including practically every job in the laying of a large pipe line.

▸ **M. E. Montrose,** vice president-sales, Houston, Texas; **W. H. Siems,** export sales manager, New York; and **R. G. Roberts,** London representative, of Hughes Tool Company returned recently to their respective headquarters after an extended business trip through England, France, Netherlands, Germany, and Italy.

▸ **Horace R. McCoy** was recently appointed metallurgist for Texas Electric Steel Casting Company. Before accepting his new position with Tesco, McCoy was chief metallurgist for the Ohio Steel Foundry Company at Lima, Ohio.

McCoy has been active in such professional societies as the Steel Founders' Society and the AIME. He has been especially interested in standardizing foundry procedures, and in that connection has compiled over a hundred "Standard Practice Instructions and Procedures" for Steel Foundry Managers' Committees. He has directed research work and analytical studies of foundry operations and products over a period of 35 years.

▸ **Roy A. Curl** has been appointed manager of The Youngstown Sheet and Tube Company's sales promotion department, succeeding **Myron S. Curtis,** who recently was appointed assistant to the president.

Curl joined The Youngstown Sheet and Tube Company in 1925 and for the last 15 years has been assistant to the sales promotion manager.

CUT VAPOR LOSSES
The Simple, Low Cost Way

Evaporation losses, both breathing and filling, can add up to big money lost in thin air.

Today there is a simple, low-cost method of vapor conservation — the VULCAN BREATHER BALLOON. It is a collapsible and expansible balloon constructed of a special synthetic rubber coated fabric. In a simple installation it is connected to any tank. Escaping vapors flow into and are trapped in the balloon during periods of high temperature, condensing back into the tank at night, or when temperature lowers.

The breather balloon is light, compact, easily and economically shipped. It needs only a simple housing, and will pay for itself quickly in savings.

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VULCAN PROOFING COMPANY
First Avenue and 58th Street
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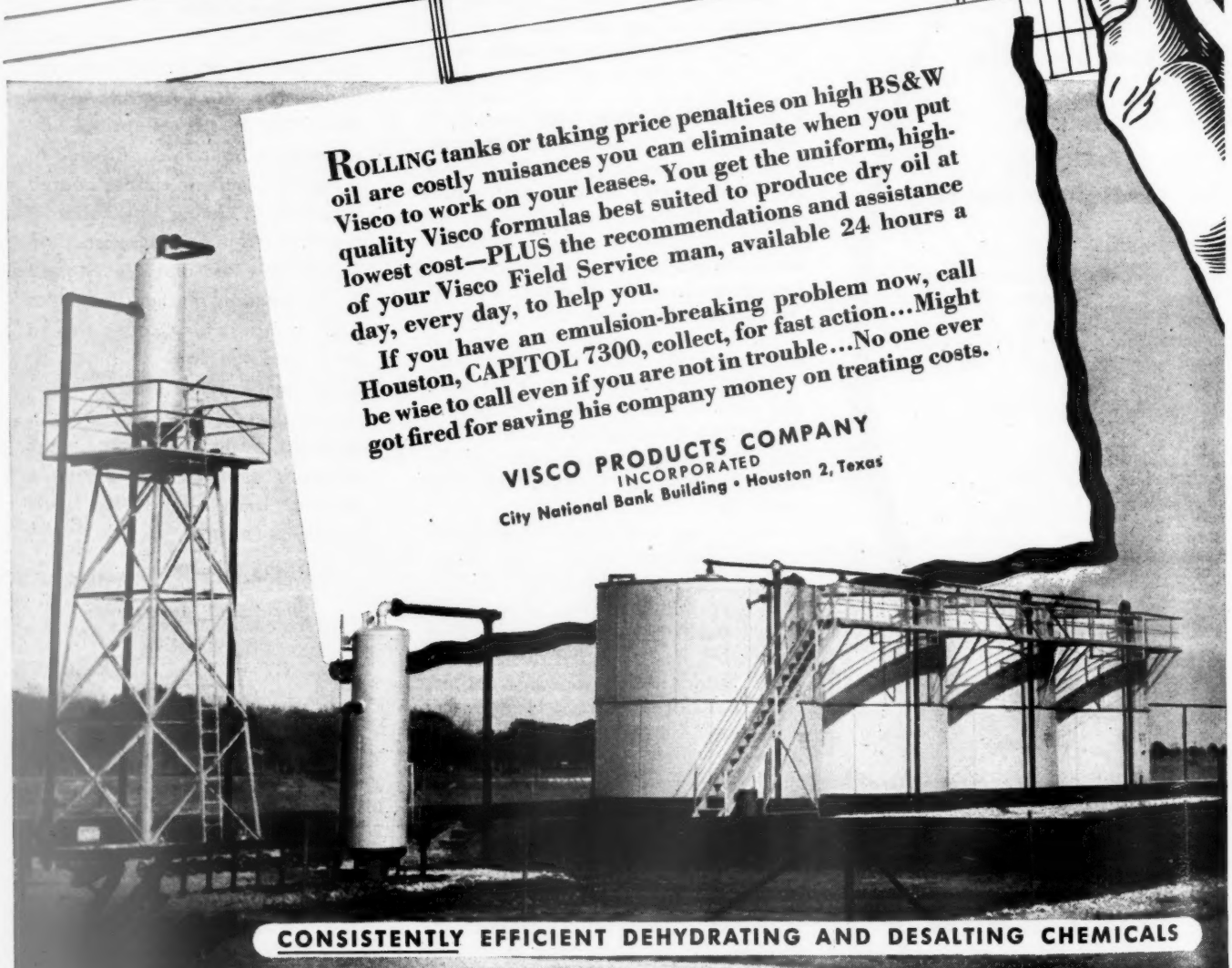
A BARREL OF BLUE

TO STOP LOSSES LIKE THIS

Rolling tanks



ROLLING tanks or taking price penalties on high BS&W oil are costly nuisances you can eliminate when you put Visco to work on your leases. You get the uniform, high-quality Visco formulas best suited to produce dry oil at lowest cost—PLUS the recommendations and assistance of your Visco Field Service man, available 24 hours a day, every day, to help you.

If you have an emulsion-breaking problem now, call Houston, CAPITOL 7300, collect, for fast action...Might be wise to call even if you are not in trouble...No one ever got fired for saving his company money on treating costs.

VISCO PRODUCTS COMPANY
INCORPORATED
City National Bank Building • Houston 2, Texas

CONSISTENTLY EFFICIENT DEHYDRATING AND DESALTING CHEMICALS

NOTICE: Visco Products Company is authorized to manufacture and sell Visco Oil Treating compounds for use in the breaking and resolving of oil emulsions, and to grant licenses for such use, under the following United States patents: 1,860,562; 1,860,563; 1,912,330; 1,937,259; 2,050,639; 2,050,640; 2,206,589; 2,214,782; 2,214,784; 2,225,189; 2,303,414; 2,307,813; 2,318,034; 2,318,035; 2,321,056; 2,335,554. Re. 20,117 and patents pending. Any purchaser of Visco Oil Treating compounds is authorized to use the name in the treating, breaking and resolving of oil emulsions in accordance with the above patents. The royalty for such use is included in the purchase price. Visco Products Company is authorized to and is willing to grant licenses on a royalty basis, to all companies, and to others desiring to practice the patented subject matter, under any and all of the above patents, permitting the user to purchase the oil treating compounds at will from any vendor, and to prepare the compounds for use under the above patent or patents, at a royalty charge of 20 cents per gallon. Application for license should be made to **Visco Products Company**, Houston, Texas.

new and improved machinery and equipment

A REGULAR FEATURE
appearing in
THE Petroleum Engineer
Irwin-Keasler Building
Dallas 1, Texas

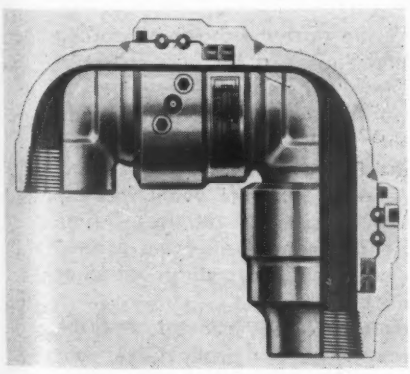
(1) Spinning Line Swivel

Otis Equipment Company is now featuring a patented chain retainer that permits replacing spinning chains without cold shuts or missing links. Available in seven models, to provide for any combination of chain, wire line, and manila rope, all parts of the swivels are of forged steel and are assembled without threads at any point. Connectors are ball-bearing equipped; bearings are grease-packed and permanently sealed. The design of the swivel permits a straight pull from the catline to either the spinning chain or tong line.

For further information contact Otis Equipment Company, P. O. Box 7326, Houston, Texas.

(2) Swivel Pipe Coupling

Specifically designed to handle the conveying of fluids under high pressure through a pipe that swivels or



rotates a full 360 deg in all planes, a ball-bearing swivel pipe coupling has been announced by Gil-Lair Products, Inc., 81 Masonic Court, Pasadena, California.

The all-flex ball-bearing swivel pipe coupling is streamlined throughout, has no projection, and is free from bolted flanges, threaded sleeves, locking rings and keys.

The low pressure couplings are made of aluminum, bronze, malleable iron or steel. They are available in a wide range of sizes, and for temperatures up to 225 F.

(3) Threading Attachment

Lehmann Machine Company, St. Louis 3, Missouri, has developed a new threading attachment, which can be furnished on any size or style of Lehmann lathes. According to the manufacturer, the device will reduce threading time, as it disengages and stops tool at the same place, no matter what the speed, and close to a shoulder without thread relief and with perfect safety. It automatically and simultaneously disengages half nuts and backs out tool on contact with automatic stop. The new Lehmann threading device may be set for external or internal, right hand or left hand, and straight or tapered threads, and enables an inexperienced operator to equal the speed of an expert.

(4) Coupling

A new Magic-Grip coupling has been announced by Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin. Interchangeable with the old standard coupling, the new one, for the present, is available in two bore sizes — $\frac{5}{8}$-in. and $2\frac{1}{8}$-in.

An adaptation of the Magic-Grip sheave principle, the Magic-Grip coupling consists primarily of two cast iron discs with tapered bores, rubber covered tubes assembled on studs, split tapered bushings, and two set screws for each disc.

Get Full Details of February, 1950, Listing—Check and Mail Coupon to

THE PETROLEUM ENGINEER
P. O. Box 1589, Dallas, Texas

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
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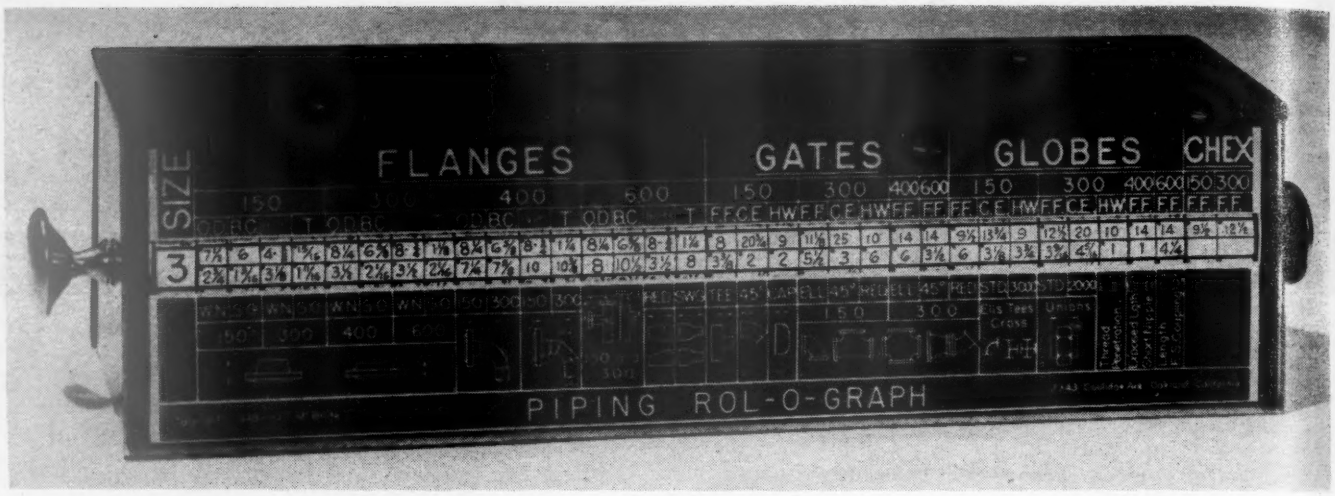
NAME ..... TITLE .....

COMPANY NAME .....

STREET ADDRESS .....

CITY ..... ZONE NO. ..... STATE .....



(5) Piping Dimensions

A tabulated roll of piping dimensions has been enclosed in a plastic case approximately 2 x 2 x 9 in. long. For all pipe sizes from ½ in. to 24 in. there are listed some 66 key dimensions pertinent to any given line size. The layout man, draftsman, or detailer, working on one line size, may choose his dimension without raising his hands from his work or paging through a catalogue. The possibility of reading in the wrong column is avoided, as only one line size shows. All A.S.A. dimensions are coded on the chart.

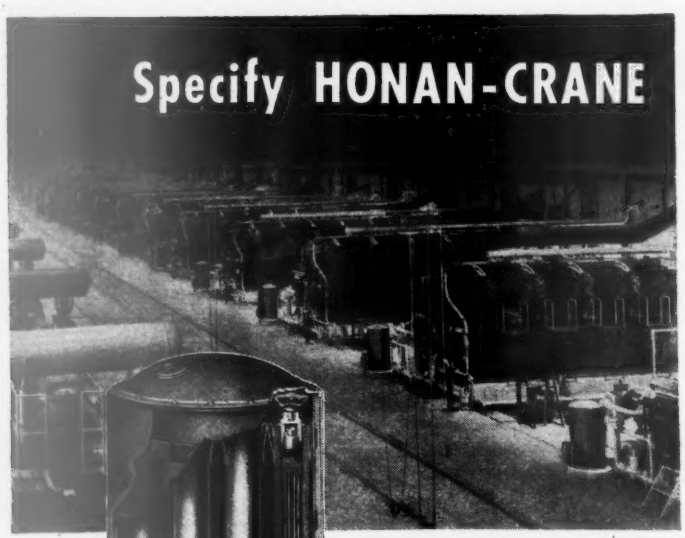
Requests for further information may be sent to G. I. McBride, 2844 East 99th Street, Cleveland, Ohio, or 2343 Coolidge Avenue, Oakland, California.

(6) Rotary Swivel Joint

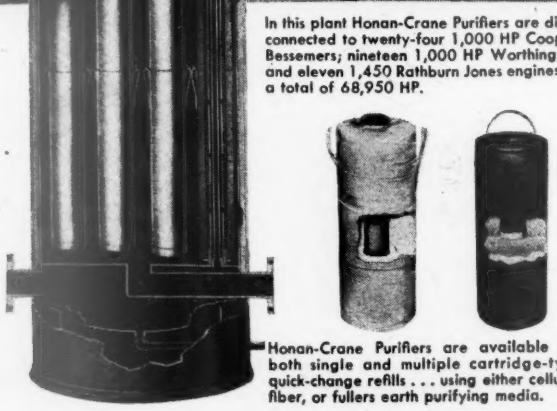
The Barco Manufacturing Company has announced a new rotary swivel pipe joint for swivel and slow revolving applications. The design of this joint eliminates wedge action of the ball against the gasket, thus turning torque is almost completely eliminated. The ball is held in place by a Belleville spring.

Successful performance has been obtained at continuous rotation up to 30 rpm. It will handle practically all fluids and gases including corrosive acids and alkalis, the manufacturer has stated. Presently available in 90 deg angle and straight designs in ⅜-in. to 1 in. pipe sizes. For information, write Barco, Dept. 101, 1801 West Winnemac, Chicago 40, Illinois.

Specify HONAN-CRANE Oil Purification for DIESELS



In this plant Honan-Crane Purifiers are direct connected to twenty-four 1,000 HP Cooper-Bessemers; nineteen 1,000 HP Worthingtons and eleven 1,450 Rathburn Jones engines . . . a total of 68,950 HP.



Honan-Crane Purifiers are available with both single and multiple cartridge-type, quick-change refills . . . using either cellulose fiber, or fullers earth purifying media.

Proven Design Increases Safe-Use Life of Oil... Cuts Maintenance Costs

Honan-Crane Oil Purifiers are the choice of leading Diesel operators and engineers for purification of lubrication oils in Diesel Engines.

Honan-Crane's purifiers remove abrasives, acids, sludges and all other types of damaging contamination . . . give maximum protection against bearing failure . . . extend safe-use life of oil, thereby reducing the need for frequent oil changes. Design characteristics of Honan-Crane Purifiers have been tested thoroughly for many years under all kinds of operating conditions.

On-the-job performance has proved that the *best* saves you *most* in the long run. Give your diesels the finest protection you can buy . . . specify HONAN-CRANE.

For complete information (or, a Honan-Crane resident engineer will call at your request) . . . write to Honan-Crane, 579 Wabash Avenue, Lebanon, Ind.

HONAN-CRANE CORP., Lebanon, Indiana
Subsidiary of HOUDAILLE-HERSHEY CORP.

...easier and better the WeldELL way

For the *practical* facts about pipe welding fittings go to the *practical* men...the welding foreman; the pipe fitter foreman; the construction superintendent... who have used all kinds and know the field.

They will tell you that the job moves faster and costs stay down when WeldELLS and other Taylor Forge fittings are used

...because of the precision quarter markings, the sized end tangents, the accurate machine tool bevels and lands.

They will tell you that the job maintains momentum easier, smoother

...because of the completeness of the line and better identification markings.

They can tell you...at least, design men will...that the *finished* job is better

...because it is done with fittings that are engineered down to the last detail to meet all requirements of *every job.*

Yes, "WeldELLS have everything"...to make it *easier ...better.* Coupon brings lots of facts.

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508-0250

(7) Control Manifold

A blowout preventer control manifold has been designed and manufactured by Portable Bridge and Equipment Company, Gulf Building, Houston, Texas. The manifold provides a compact distributing system for steam, water, and high pressure operating fluid to the preventers, all skid mounted in a unit of 30-in. wide and 10-ft long with a lift chain at the center of gravity. Included is a platform for mounting the hydril control manifold, which may be connected permanently to the high pressure system and transported in a protected position.

(8) Deaerating Heater

Graver Water Conditioning has manufactured a new deaerating heater designed to reduce the oxygen content of boiler feedwater to less than 0.005 ml per liter measured by the ASTM referee method or modified winkler test regardless of rapid load variations or unusual operating conditions. Carbon dioxide is also completely removed.

These results are provided by the new two-stage Graver deaerating heater, in which the special design of spring-loaded, self-adjusting spray valves in the first stage causes heating of the incoming water to within 2 to 4 deg of the steam so as to remove virtually all the oxygen and free CO_2. In the second stage, the preheated water is mixed with a large excess of incoming steam by means of specially designed scrubbing baffles, so that the major portion of the steam that remains as vapor carries with it the small traces of undissolved gases on its way to the first stage where it heats the incoming water. Further information may be obtained from Graver, 216 West 14th Street, New York.

How to Keep

COST DOWN

on Valve Maintenance

Cleaning one valve before overhaul won't amount to much in time or money, that's true! But multiply that one valve by thousands—at year's end your expenditure will be pretty high.

If your valve maintenance-cleaning runs into big money, we believe we can help you hold your costs way down. We believe (and many refiners will agree) that Oakite Steam-Detergent cleaning with the Oakite Solution-Discharging Steam Gun will prove infinitely superior to manual scrubbing . . . ON ALL COUNTS. It's quicker, more efficient and decidedly more economical.

Oakite Steam-Detergent cleaning is a lead-pipe cinch to install. All you need is the Oakite Gun, plus 30 lbs. steam pressure; a couple of lengths of rubber hose, and an old steel drum for your cleaning solution. You need no motor, no injector, no pump.

And the beauty of Oakite Steam-Detergent cleaning is that you can reach those hard-to-get-at-places. You can use it on all kinds of equipment. You can strip paint with it.

Free 8-page folder gives all the facts on Oakite Steam-Detergent cleaning. Get yourself a copy today. No obligation.

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Technical Service Representatives in Principal Cities of U.S. & Canada

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PETROLEUM SERVICE DIVISION

(9) High Pressure Seal

A high pressure seal, designed to meet the sealing requirements of equipment handling hydrocarbons under high pressures and temperatures, is announced by the Felt Products Manufacturing Company.

The new Fel-Pro Type H-P Seal incorporates three major improvements, which according to the manufacturer, assure complete sealing with longer equipment life, trouble-free operation and minimum maintenance costs.

Fel-Pro Type H-P Seals are designed to handle a variety of liquids at pressures up to 600 psi and temperatures up to 250 F in centrifugal pumps and other equipment handling crude oils, gasoline, propanes, etc. A comprehensive data sheet may be obtained by writing to Felt Products, Packing Division, 1508 Carroll Avenue, Chicago 7, Illinois.

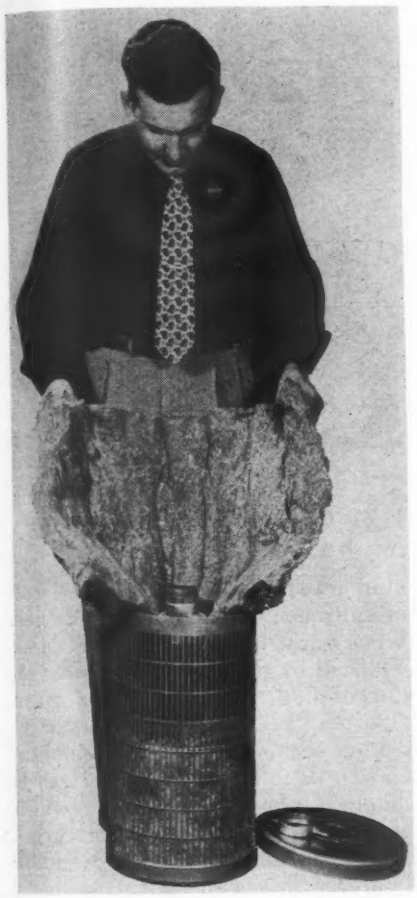
(10) Illuminated Dial Gage

Helicoid Gage Division of American Chain and Cable Company, Inc., Bridgeport 2, Connecticut, has added

to its line an illuminated dial gage. The dial is lighted like the new automobile speedometers with black light that glows in the dark. It has a black background with ultraviolet phosphorescent pointer, numerals and graduations, or plain white illumination may be supplied.

(11) Oil Filtering Material

A new, high-efficiency filtering material developed during the war is now commercially available from The Hil-



liard Corporation, 102 West Fourth Street, Elmira, New York. Hiltex is a combed, high-grade cotton with Sequoia bark fibers — resulting in a material of uniform density easily handled and evenly packed into filter cartridges.

Light weight permits use of less materials per cartridge filling, but at the same time gives more dirt storage capacity than conventional cotton waste threads. Hiltex is supplied in 2½ lb batts, and operators find it easy to pack correct amount in filter cartridges, as shown by the photograph. Because it is a cellulose product, Hiltex is suitable and approved for filtering of mineral, heavy-duty, additive and detergent type oils.

(12) Steam Turbines

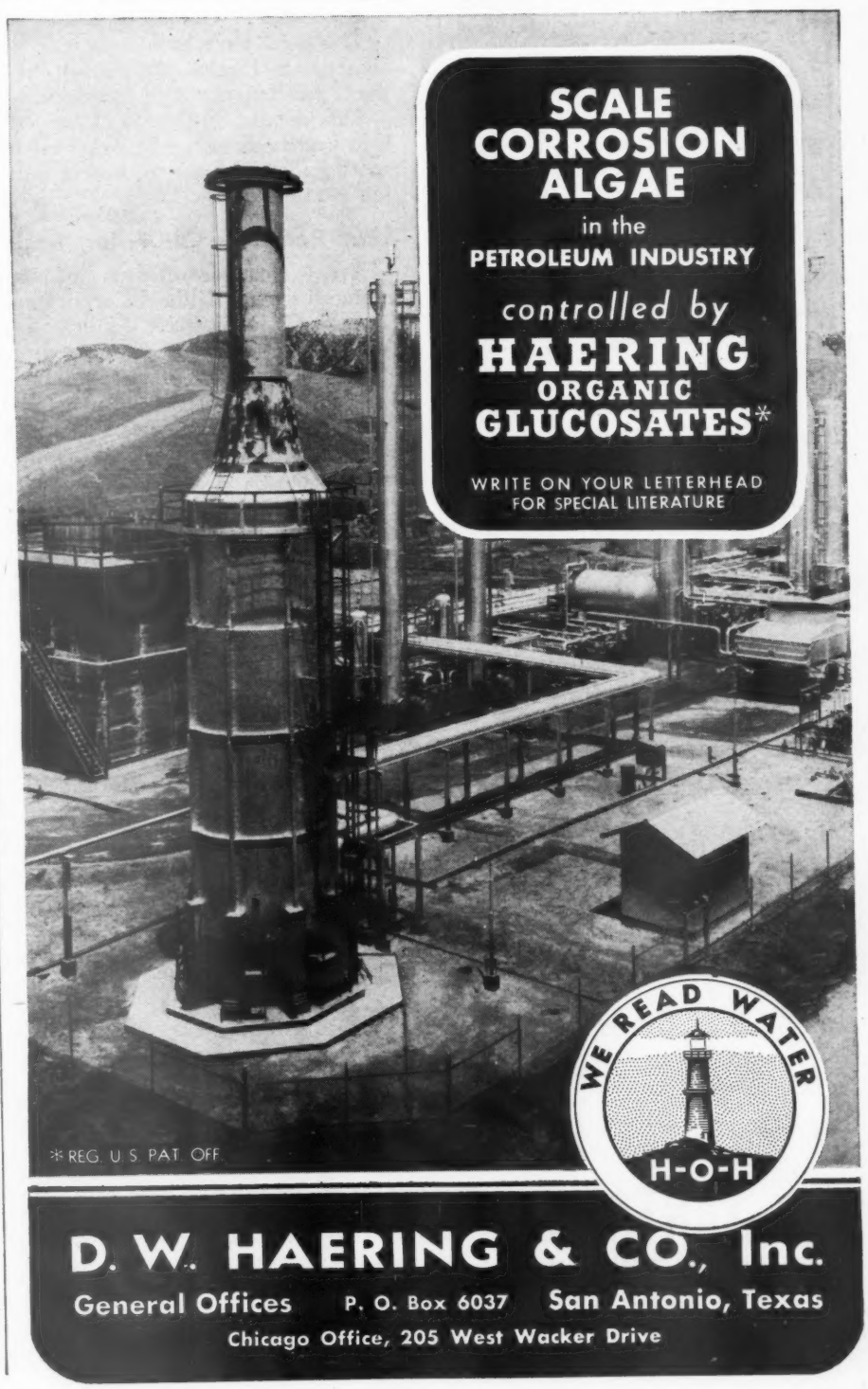
Type E industrial steam turbines with close-coupled, integral reduction gears for low-speed applications are available from Westinghouse Electric Corporation. Equipment such as pumps, fans, compressors, and generators can be driven at proper speeds by these Gearturbines while the turbines operate at their most efficient speed. For further information write Westinghouse Electric Corporation, P. O. Box 2099, Pittsburgh 30, Pennsylvania.

(13) Aluminum Pigment

An aluminum pigment designed specifically for painting of tanks, buildings, towers, piping and other petroleum process equipment, as well as industrial interiors has been introduced by Metals Disintegrating Company, Inc., Elizabeth, New Jersey. This recent development is an all-purpose pigment producing films of greater whiteness and brightness.

(14) Straight Centrifugal Pumps

The addition of a new line of straight centrifugal pumps has just been announced by Marlow Pumps, Ridgewood, New Jersey, which expands the full Marlow line to 56 basic series of pumps. The new centrifugals amplify Marlow's lines of self-priming centrifugals, diaphragm, and plunger pumps to make a complete range of four different types. They are introduced for use primarily on installations with flooded suctions and are offered in close—or long-coupled construction, 1 to 4-in. sizes and with capacities from 10 to 1000 gpm.



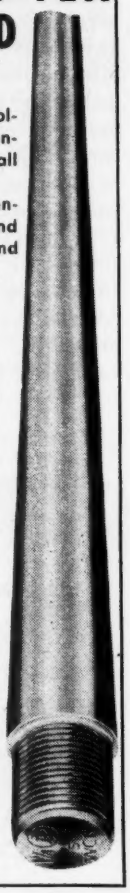
NORRIS NOR-TEX A. P. I. POLISHED RODS

There's a NORRIS NOR-TEX Polished Rod for every pumping condition. Rods are available in all API lengths and pin sizes.
Each NORRIS Polished Rod is identified as to rod and pin size and type of metal by a number and letter stamped on the rod end.

POLISHED ROD LETTER IDENTIFICATION

C COMMON STEEL. 80,000 Lbs. Tensile Strength
P PISTON STEEL. 110,000 Lbs. Tensile Strength
N NOR-LOY NICKEL MOLY. 98,000 Lbs. Tensile Strength
S RESISTAL STAINLESS. 90,000 Lbs. Tensile Strength
M MONEL. 110,000 Lbs. Tensile Strength
B BRONZE. 85,000 Lbs. Tensile Strength
A AMPCOLOY. 112,000 Lbs. Tensile Strength

For complete information write for Bulletin No. 28-B.



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(15) Heat Exchanger

Expanding its redesigned line of heat exchangers available from stock, Young Radiator Company, 709 Marquette, Racine, Wisconsin, announces its new Type "R" (removable tube bundle) shell and tube heat exchangers.

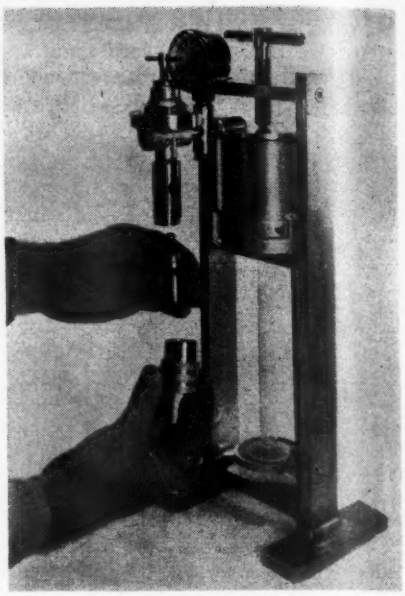
The company has stated that its Type "R" heat exchangers are of corrosion-resistant Admiralty metal tubing. Larger tube sizes (3/8-in. OD and 5/8-in. OD), plus engineered tube spacing and baffling, provide longer unit life, easier maintenance, and maximum heat transfer efficiency. The line consists of both single and two-pass models in various capacities.

The units have been especially designed for: Engine cooling, oil cooling, miscellaneous fluid cooling.

Full details on Young Type "R" heat exchangers may be obtained by writing the company requesting Catalog No. 1149.

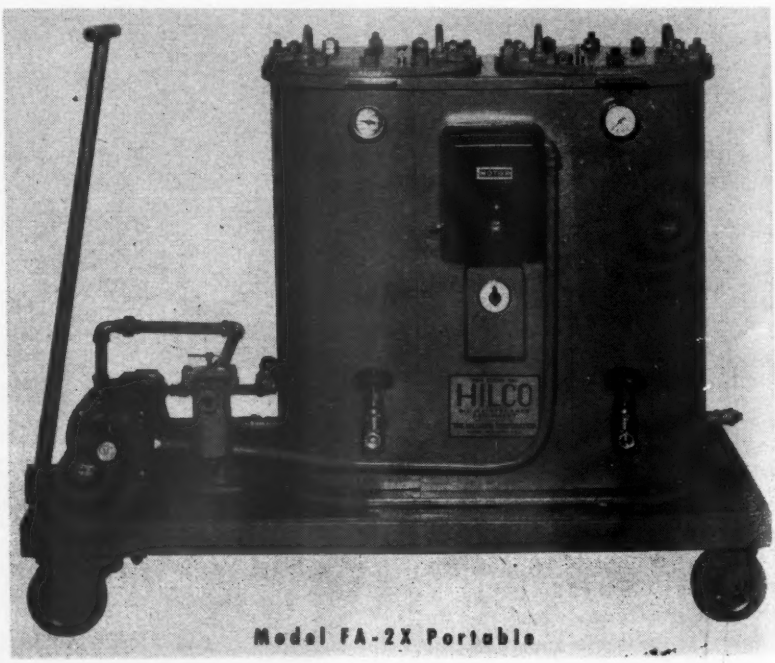
(16) Portable Oil Filter

A new portable oil filter, just announced by the Hilliard Corporation, 102 West Fourth Street, Elmira, New York, is arranged for wheeling up to diesel engines or other equipment containing lubricating oil that requires periodic filtering. The unit consists of a filter assembly with or without electric heaters, and contains one or more filter cartridges. The cartridges can be packed with fuller's earth for the filtration of straight run mineral oils, or of cellulose for the filtration of heavy-duty or compounded oils. The entire unit is assembled on a base with ball-bearing casters, rubber-tired, and with a drawbar for moving the unit.



(17) Cylinder Pressure Unit

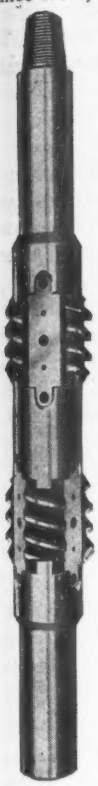
The fann midget cylinder pressure unit, which eliminates the use of air or nitrogen bottles on mud filter presses now in the field, has been announced by the Magnet Cove Barium Corporation, 5001 Richmond Road. Houston, Texas. Pressure for the filtration test is supplied by thumbsize carbon dioxide cylinders that can be obtained almost everywhere, which, according to the manufacturers, makes this unit particularly desirable in areas where a continuous source of compressed nitrogen is difficult to obtain. The midget cylinder pressure unit eliminates the need for the bulky nitrogen cylinders now in use, and the inconvenience of shipping and receiving these cylinders. Complete details will be furnished by the company.



Model FA-2X Portable

(18) Casing Scraper

Following extensive field performance tests, Baker Oil Tools, Inc., Box 2274 Terminal Annex, Los Angeles, California, is introducing the roto-vert casing scraper for removing gun-shot burrs, imbedded bullets, cement or mud sheath, and other similar obstructions from the inside walls of the casing.



The new roto-vert casing scraper is intended to supplement, rather than to place the Baker Model "B" casing scraper, which is still recommended for use above the drilling bit to remove cement sheath and burrs when a limited number of test gun perforations are present. The roto-vert is recommended by the manufacturer, where it is desired to scrape away the mud sheath from top to bottom of the hole and/or where a large number of gun-shot burrs (with possible imbedded bullets) are to be removed.

The blade blocks are set in two horizontal rows in a staggered position so that the scraper blades overlap and insure effective scraping of the full 360 deg inside wall surface of the casing.

(19) Loom Motor

The Louis Allis Company of 427 East Stewart Street, Milwaukee, Wisconsin has recently announced the development of a new ball bearing loom motor. The development of this new loom motor incorporates findings that were established in a series of comprehensive tests that were performed to settle the long controversy over the most satisfactory loom motor design.

(20) Pressure Snubbers

The Chemiquip Company, 193 Bradford Street, Brooklyn 7, New York, announces the availability of a new Micro Metallic Corporation all monel pressure snubber, in addition to their standard line of stainless steel and brass snubbers. These monel snubbers, the company has stated, have a greater corrosion resistance to certain types of liquids or gases than stainless steel or brass, and are indicated for use with all monel pressure instruments presently being offered on the market. They are designed to protect pressure gauges and other pressure instruments from shock due to sudden pressure development or release.

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RECIPROCATING PUMPS

PUMPS

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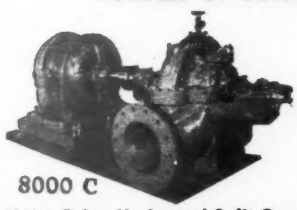
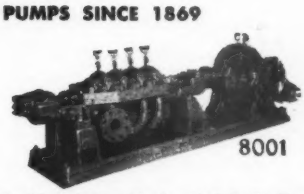


8000 C

Motor Drive Horizontal Split Case Double Suction Centrifugal Pump

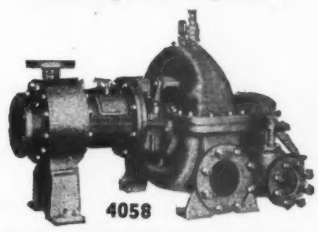


8001

Turbine Drive Horizontal Split Case Multi Stage Centrifugal Pump

4049 A

Two Stage Close Coupled Centrifugal Pump

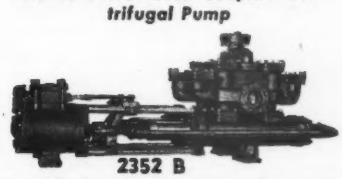


4058

Turbine Drive Close Coupled Centrifugal Pump

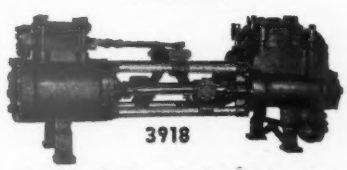
942

Single Style, Packed Piston Pattern Steam Pump



2352 B

Durable Duplex, Outside End Packed, Plunger Pattern Steam Pump



3918

Durable Duplex, Packed Piston Pattern Steam Pump

3833

Horizontal Duplex, Double Acting, Side Pot, Piston Type, Oil Bath Power Pump

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trade literature

PUBLICATIONS LISTED ARE SENT FREE UPON REQUEST

(21) High-Speed Diesels

Sixty-eight high-speed diesels for automotive, industrial, and marine applications, covering the entire power range from 50 to 550 hp, and three medium-speed diesels, are described in a new 36-page condensed catalog just issued by Cummins Engine Company, Inc., 5th and Watson Streets, Columbus, Indiana. The catalog lists for the first time 27 new Cummins models introduced within the last 12 months.

Comparative charts, listing the major specifications for each engine, are included in the catalog to assist in the preliminary selection of a Cummins diesel for any specific application.

Copies of the catalog, Bulletin No. 5218C, can be obtained from the 200 Cummins Dealers, or Cummins Engine Company, Inc., Columbus, Indiana.

(22) Levels and Transits

Two new pocket-size service booklets have been released by W. and L. E. Gurley, Troy, New York, concerning the adjusting of surveying transits and wye, dumpy, and precision tilting levels.

Adjustments of transits, suggestions on care and maintenance, and causes of mechanical and instrumental errors and their correction are included in Service Booklet "A," while Booklet "B" contains similar information on levels.

Free copies of the booklets may be obtained by writing W. and L. E. Gurley.

(23) Specially Designed Gloves

For 30 years Wicx-Merit Glove Company, 1085 Mission St., San Francisco, California, has been making gloves for all the ramified purposes of American industry. Safety, flexibility, strength, and durability are the basic requirements of work gloves, but unusual conditions demand special qualities and materials. The manufacturers state that they not only manufacture a wide variety of gloves for a diversity of uses, but, knowing the involved conditions, are in a position to fashion an effective glove for any function that may develop. Meantime, for those interested a glove catalog may be had on request, and help in designing gloves for special needs is available.

(24) Excavator

An increase in lift capacity ratings was recently announced by the Koehring Company of Milwaukee for three sizes of excavators currently produced by the firm. In published specification charts, maximum capacity of the Model 304 Koehring excavator has been established at 13.9 tons with crawler mounting, and 25 tons on both the rubber tire mounted truck and cruiser cranes.

The new specifications also show an increase for the crawler mounted Model 605 machine, which is now listed at 36 tons. The lifting capacity of the Model 1005, latest addition to the Koehring line of heavy-duty excavators, has been tabulated at 79½ tons maximum. Copies of these new specification charts may be obtained on request to the Koehring Company, Milwaukee 10, Wisconsin.

(25) Flow Control Unit

A new 16-page illustrated booklet that gives complete engineering specifications on the O-C-T "JE" flow control unit is now available from Oil Center Tool Company, Box 3091, Houston, Texas. In addition to describing the O-C-T "JE" flow control unit in detail, the booklet also gives weight and price comparisons with conventional wings.

(26) Hard Metals (English-Spanish)

Eighteen months ago, Stoody Company, 1134 West Slauson, Whittier, California, published its booklet entitled "Oil Field Applications of Stoody Hard-Facing Alloys," a manual covering the common uses of hard metals on drilling equipment. A Spanish translation of the book that would make it suitable for use in Venezuela, Mexico, and other Spanish-speaking countries has now been published, with all applications described in both English and Spanish, and with illustrations titled in both languages. Each page carries the English descriptive matter with its Spanish equivalent.

The booklet is available upon request to Stoody Company and may also be had from National Supply Export Corporation, distributor in foreign oil fields for Stoody alloys.

(27) Gas Lift Valves

Spartan Gas Lift Equipment Company, 1554 W. Mistletoe, San Antonio, Texas has recently published a brochure in which is included a list of the features of the Spartan gas lift valves. The manufacturer maintains that the Spartan is capable of being opened or closed in two opposite directions with a single moving part; that it can be completely dismantled, reconditioned, and reset at the well site.

(28) Multi-Layer Vessels

A. O. Smith Corporation, 3533 North 27th Street, Milwaukee, Wisconsin, has issued a new illustrated 8-page bulletin on the manufacture and assembly of its Multi-Layer vessels. This bulletin, No. V-52, titled "Multi-Layer Manufacture and Assembly," is the first in a series of bulletins on Multi-Layer vessels. Others in the series will follow.

(29) Chemical Injector

A complete description and specifications of the new McFarland chemical injector are contained in the fully illustrated, 2-color 4-page folder, now ready for distribution. Copies of the folder may be obtained from McFarland Manufacturing Company, 1630 Roberts Street, Houston.

(30) Tractor Manual

A new 220-page service manual featuring Allis-Chalmers' HD-5 crawler has just been released by the company's tractor division. Instructions include a complete guide on proper operation, maintenance, and repair of this new post-war tractor. This new service book is separated into 23 sections.

Copies of this new HD-5 tractor service manual can be obtained for $3.00 each at any Allis-Chalmers industrial dealer or the Allis-Chalmers Mfg. Company, tractor division service department, Box 512, Milwaukee 1, Wisconsin.

(31) Reservoir-Type Manometers

Minimum mercury contamination and easy cleanout are among the features of a line of reservoir-type manometers announced by King Engineering Corporation.

To prevent contamination of the indicating liquid, the drain and cleanout plugs are straight-threaded and gasket-sealed, eliminating the use of sealing compound on all threads below the surface of the liquid, according to the manufacturer.

Full details, including specifications and prices, are given in illustrated Bulletin M-101, available on request from King Engineering Corporation, Box 100, Ann Arbor, Michigan.

(32) Diesel Engines

Diesel engines for stationary installations are described and illustrated in a new 20-page bulletin, No. 4812. The bulletin features 60 years of Superior engine research and production development, and numerous installations of these engines within the past three years in municipal power plants, in public utility power plants, industrial power plants, office buildings, and others.

Included are more than 100 engine specifications showing a range in power from the naturally aspirated, 6-cyl, 175-hp engine with 8½ x 10½-in. bore and stroke, to a supercharged, 8-cyl, 1500-hp engine with 14½ x 20-in. bore and stroke.

Copies are available from Superior Engine Division (Springfield, Ohio) or The National Supply Company, Toledo, Ohio.

(33) Pressure Cells

The Baldwin Locomotive Works recently published Bulletin 306, describing and giving complete specifications for SR-4® (resistance wire strain gage type) pressure cells of 8 capacities from 200 to 50,000 psi. A wiring diagram and cross-sectional sketches of the cell and seal-off unit are included. The bulletin supersedes Bulletin 270. Copies are available from The Baldwin Locomotive Works, Testing Equipment Department, Philadelphia 42, Pennsylvania.

(34) Oil Well Equipment

Larkin and Company, Inc., of Butler, Pennsylvania, manufacturers of oil and gas well equipment, have announced the completion of its new C-60 catalog. It lists and illustrates Larkin's entire line of packers, bailers, sand pumps, and other equipment incident to secondary recovery. Index and ordering procedure are included. Available immediately, together with current Price Book No. 60 and discount sheet, upon request to manufacturer.

(35) Joints On Unions

Chiksan Company, P. O. Box 158, Brea, California, has published for its loose-leaf binder, Catalog No. 50, 44 pages, on ball-bearing swivel joints. List prices of the joints are carried, along with a description of other Chiksan products.

Included in the folder, is Well Equipment Manufacturing Corporation's list of manufacturers and distributors. Instructions for ordering, price lists, and information on blocks, burners, compounds, thread, handles, valve, lubricators, unions and parts, and other products are listed in this 28-page catalog.

(36) Mastic Composition Board

A 4-page brochure on the properties, uses, and costs of Kapco Rock Shield, a mastic composition board designed to protect pipe and coating from rock and other cutting or scraping surfaces, was recently made available by the Midwestern Engine and Equipment Company, Inc., of 105 N. Boulder, Tulsa, Oklahoma. The outstanding element of the brochure is an "Estimating Table," which enables the pipe line contractor to compute, in advance, the exact Kapco cost for protecting the pipe he has contracted to lay.

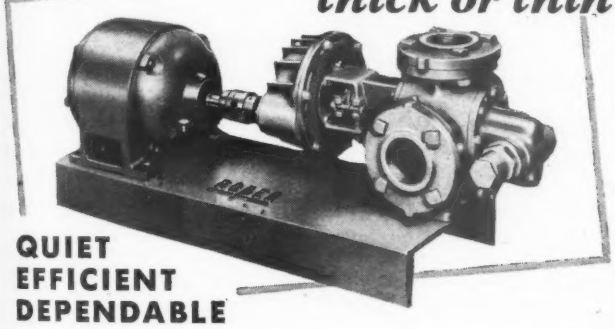
Copies of the brochure may be obtained from Midwestern upon request.

(37) Leak Detector

A new 16-page two-color catalog describing the Consolidated leak detector has been published by the Consolidated Engineering Corporation, 620 No. Lake Avenue, Pasadena, California.

The leak detector bulletin has a large section devoted to applications and leak detection methods used in both vacuum and pressure systems. Operation, performance, and features of the instrument are described. Accessories, spare parts, and specifications are listed. Information on service and exporting completes the catalog.

PUMPS for CLEAN LIQUIDS
thick or thin



QUIET
EFFICIENT
DEPENDABLE

This Roper 3600 Series Pump is a motor-driven unit with totally enclosed anti-friction gear reduction, mounted on a steel bedplate. Furnished with or ready to receive a standard motor. Capacities from 40 to 100 g.p.m. Other models in double and multiple units also available. Roper motor-driven pumps are highly efficient for pumping oils, greases, solvents, thinners, paints, syrups, etc. in industrial plants and process industries. They handle a wide range of thick or thin clean liquids efficiently, quietly, economically.

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ROPER Rotary Pumps

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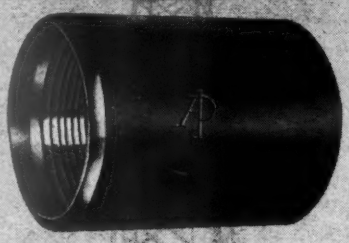

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OIL WELL TUBING COUPLINGS

"X-L" Quality Oil Well Tubing Couplings are carefully and accurately made to assure perfect alignment, tighter joints and to protect vanishing threads. Available in Plain or External Upset for standard tubing. Manufactured from steel; tested by Comparator to assure strict adherence to A.P.I. standards. "X-L" Couplings are used by every pipe mill in the United States and Canada.

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Use Our Catalog Description
When Ordering Couplings!

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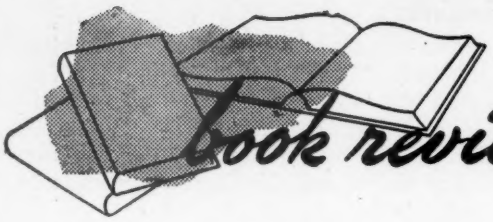

▸ **Stratigraphy and Petrology of Buck Hill Quadrangle, Texas,** *by Samuel S. Goldich and Morris A. Elms. Reprinted from Bulletin of The Geological Society of America. Pages 50. Price, .50.*

This 50-page report on the Buck Hill quadrangle is accompanied by six figures and six plates including a geologic map in color. The quadrangle is a favorable area for detailed studies of the tertiary stratigraphy and petrology of the southern Davis Mountains, and this report is the culmination of field investigations carried on in 1936 and 1940 with additional work in 1946.

▸ **Physical Principles of Oil Production,** *Morris Muskat, McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 18, New York. Pages, 922. Price, $15.*

The objective of this book is the formulation and correlation of present information concerning the physical principles and facts underlying the mechanics of oil production. Also, the author hopes to stimulate and encourage additional research and study of the subject to fill in the many gaps in our present knowledge, and to improve the correlation between laboratory theories and field observations. The approach consists in the detailed analysis of the physical concepts and principles that are developed as foundations for the interpretation and study of actual oil field performance. The theories of such performances are developed fully, and their implications are illustrated graphically and numerically.

▸ **Reviews of Petroleum Technology, Vol. 8,** *by George Sell, editor, The Institute of Petroleum, Manson House, 26 Portland Place, London, W. 1. Pages, 443. Price, 27s. 6d. Post free.*

With this volume, the Institute of Petroleum of England resumes annual publication of its Reviews of Petroleum Technology. This volume covers in the main the year 1946, but includes chapters that had to be omitted from the previous volume (1941-45). Probably the most important of these is the chapter on Lubricants and Lubrication that, for the period 1941-6, occupies 73 pages and contains references to over 1000 articles in the literature and patent specifications.

▸ **Empire Oil,** *by John P. Herrick. Dodd, Mead, and Company, 432 Fourth Avenue, New York, New York. Pages, 474. Price, $5.*

Empire Oil presents the history of the discovery of oil in the state of New York. From the rich lore of newspaper files, county clerks' records, eyewitness accounts, and personal experiences, the author has reconstructed the complete story of the discovery and development of petroleum in the Empire State, from Father de la Roche d' Allion's visit to an oil spring near Cuba, New York, in 1927, to the modern secondary recovery methods that rejuvenated the rapidly waning oil field of eastern United States. With proper emphasis and chronological order the stories of crude oil and natural gas production, nitroglycerin, pipe lines, refineries, and secondary recovery, are depicted with sharp focus on the men and women whose qualities made this industrial progress possible. Herrick, an oil region journalist and publisher in the 1890's and a successful oil producer for more than 40 years, spent 10 years in research to corroborate and sort the material that resulted in *Empire Oil.*